MEDICAL PROCEEDINGS

MEDIESE BYDRAES

A South African Journal for the Advancement of Medical Science

'n Suid-Afrikaanse Tydskrif vir die Bevordering van die Geneeskunde

P.O. Box 1010 · Johannesburg | Posbus 1010 · Johannesburg

Editor : Redakteur

H. A. Shapiro, B.A., Ph.D., M.B., Ch.B., F.R.S.S.Af.

Vol. 6 | 22 October 1960 Oktober 22 | No. 21

EDITORIAL · REDAKSIONEEL

STAPHYLOMYCIN

ANOTHER NEW ANTIBIOTIC

Staphylomycin is a new antibiotic obtained from a streptomyces related *Streptomyces virginiae*, isolated in 1954 from a sample of Belgian soil.

The spectrum of Staphylomycin is closely related to that of erythromycin, although the chemical structure of both these products is very different. As an antibiotic it is very active against the gram-positive cocci. With the exception of *H. pertussis*, it is not, however, active against the gram-negative micro-organisms. It is very active against staphylococci resistant to other antibiotics. At relatively low concentrations it has bactericidal activity; in smaller concentrations, it has bacteriostatic activity. The bactericidal activity of the antibiotic decreases progressively and proportionally to the reduction of the concentration, but there is no sudden change from bactericidal to bacteriostatic activity.

The *in vitro* development of resistance to Staphylomycin occurs, but with difficulty, and the emergence of this resistance is progressive, as in the case of penicillin.

The staphylococci which, in the laboratory, become resistant to Staphylomycin, also show a greater resistance to erythromycin, penicillin and streptomycin. However, their sensitivity to chlortetracycline, novobiocin and bacitracin does not change. The reverse phenomenon could not be observed: the staphylococci,

STAPHYLOMYCIN

NOG 'N NUWE ANTIBIOTICUM

Staphylomycin is 'n nuwe antibioticum verkry van 'n streptomyces wat aan *Streptomyces virginiae* verwant is, en in 1954 vir die eerste keer uit 'n monster van Belgiese grond afgesonder is.

Die spektrum van Staphylomycin is ten nouste verwant aan dié van eritromisien, hoewel die chemiese struktuur van die twee produkte aansienlik verskil. As antibioticum tree dit besonder aktief teen die Grampositiewe kokke op. Met uitsondering van *H. pertussis* is dit egter nie aktief teen Gramnegatiewe mikro-organismes nie. Dit is besonder aktief teen stafilokokke wat weerstand teen ander antibiotica opgebou het. Teen betreklik lae konsentrasies het dit 'n bakterievernietigende effek; in nog swakker konsentrasies is dit bakteriostaties. Die bakteriedodende aktiwiteit van die antibioticum verminder progressief en in verhouding tot 'n vermindering van die sterkte van die konsentrasie, maar daar is geen skielike oorskakeling van bakteriedodende tot bakteriostatiese aktiwiteit nie.

Die *in vitro*-ontwikkeling van weerstandskragtigheid vir sover dit Staphylomycin betref, kom wel voor, maar dit geskied met moeite en die verskyning van hierdie weerstandskragtigheid is progressief, net soos in die geval van penisillien.

Die stafilokokke wat weerstand teen Staphylomycin opgebou het, toon ook groter weerstand teen eritromisien, penisillien en streptomisien.

having become resistant to other antibiotics, kept their original sensitivity to Staphylomycin.

In test animals experiments demonstrated that the oral administration of Staphylomycin grants a protection equal to that granted by erythromycin to mice infected intraperitoneally with *Micrococcus pyogenes*.

Acute toxicity is virtually non-existent or slight in animals after a high single dose. The LD 50 (the single dose, lethal in 50% of the cases) could not be determined, since in mice the intraperitoneal injection of Staphylomycin (1,000 mg. per kg.) did not cause death. The animals appeared ill for 24 hours, then their condition gradually mended and after 48 hours appeared normal.

Chronic toxicity (studied after repeated administration of normal doses of Staphylomycin to the animals) was absent or slight.

The weight curve of the test animals developed in the same way as that of the untreated animals. The animals killed showed no pathological lesions. No haematologic changes were observed: the red and white blood corpuscles, the haemoglobin and the leucocyte pattern gave results similar to those of the tests on the untreated animals.

Prolonged clinical trials confirmed the absence of toxicity in man as well.

Clinical trials carried out on a large number of patients during an appreciable period (about 4 years) indicate that Staphylomycin is very well tolerated both by the systemic route and in local applications.

Symptoms of gastric intolerance were rare (less than 2% of the cases). Skin reactions, either cutaneous or mucous were still less frequent.

Staphylomycin is claimed to be remarkably effective against all strains of staphylococci, even those resisting other antibiotics. This fact, established in the laboratory, has been confirmed clinically. Furthermore, Staphylomycin is active against streptococci and pneumococci. These properties should ensure a wide range of therapeutic application for one of the latest additions to the antibiotic family.

Hul gevoeligheid vir chlortetrasiklien, novobiosien en basitrasien toon egter geen verandering nie. 'n Omgekeerde verskynsel kon nie waargeneem word nie: die stafilokokke wat weerstand teen ander antibiotica opgebou het, het net so gevoelig soos altyd vir Staphylomycin gebly.

In proefnemings wat met diere gedoen is, is daar bewys dat die mondelinge toediening van Staphylomycin 'n beskerming verleen gelykstaande aan dié wat deur eritromisien verskaf word aan muise wat binne-peritoneaal met *Micrococcus pyogenes* besmet is.

Akute toksisiteit is feitlik geheel en al afwesig of baie gering by diere na 'n groot enkele dosis. Die DD 50 (die enkele dosis wat in 50% van die gevalle dodelik is) kon nie vasgestel word nie, want in die geval van muise het die binne-peritoneale inspuiting van Staphylomycin (1,000 mg. per kg.) nie die dood tot gevolg gehad nie. Die diere was 24 uur lank siek. Toe het hul toestand geleidelik verbeter, en na 48 uur was hulle op die oog weer heeltemal normaal.

Chroniese toksisiteit (bestudeer na die herhaalde toediening van normale dosisse Staphylomycin aan diere) was afwesig, of net gering.

Die gewigskurwe van die toetsdiere het ontwikkel net soos dié van onbehandelde diere. Die diere wat doodgemaak is, het geen patologiese letsels getoon nie. Geen hematologiese veranderings is waargeneem nie: die rooi en wit bloedliggaampies, die hemoglobien en die leukosietpatroon het resultate opgelewer soortgelyk aan dié van die toetse met onbehandelde diere.

Langdurige kliniese proefnemings het die afwesigheid van toksisiteit ook by die mens bewys.

Kliniese proefnemings wat met 'n groot aantal pasiënte oor 'n lang tydperk (ongeveer 4 jaar) gedoen is, dui daarop dat Staphylomycin goed verdra word sowel wanneer dit sistemies as plaaslik gebruik word.

Simptome van maagonverdraagsaamheid was 'n seldsame verskynsel (minder as 2% van die gevalle). Nog seldsamer was velreaksies, kutaan of slym.

Aanspraak word daarop gemaak dat Staphylomycin merkwaardig doeltreffend is teen alle soorte stafilokokke, selfs dié wat weerstand teen ander antibiotica opgebou het. Hierdie feit wat in die laboratorium bewys is, is klinies bevestig. Temeer, Staphylomycin is ook aktief teen streptokokke en pneumokokke. Hierdie eienskappe verseker dat een van die jongste byvoegsels tot die antibioticumfamilie vir 'n groot verskeidenheid van terapeutiese doeleindes gebruik sal kan word.

ABSTRACTS

SERUM ZINC AND MYOCARDIAL INFARCTION

The serum zinc level drops in cases of myocardial infarction to about half its normal value or below, a phenomenon which is connected with the reactive adaptation of the organism.

[Rechenberger, J. (1959): Zschr. Inn. Med., **14**, 265].

TRANQUILLIZERS AND FALSE PREGNANCY TESTS

False positive pregnancy tests in patients who have received tranquillizers of the phenothiazine type can be avoided if the frogs are injected with blood serum instead of urine.

[Hodgson, J. E. (1959): J. Amer. Med. Assoc., **170**, 1890].

CERVICAL SPINE FUSION BY THE ANTERIOR APPROACH

SIDNEY SACKS, F.R.C.S. (EDIN).
Johannesburg

The objects of this paper are:

1. To describe a surgical approach to the cervical spine for the removal of the intervertebral discs and fusion of the vertebral bodies.
2. To present the indications for this procedure.
3. To illustrate results with some case reports.

It is becoming generally accepted that intervertebral disc degeneration in the cervical spine, with or without associated osteophyte formation (commonly known as cervical osteoarthritis, or spondylosis) is one of the commonest factors in middle-aged persons responsible for producing pains in the neck, shoulder, chest, arm, head and hand.

Steinert in 1954 reported that in Norway in 320 subjects aged over 40 years, 75% had radiological signs of osteoarthritis, and that three quarters of these patients exhibited symptoms related to cervical osteoarthritis.

Hult[3] found frank radiological evidence of cervical osteoarthritis in 60% of 1,200 inhabitants of one Danish village in those over 45 years of age, and in 85% of those over 65 years of age.

Gatzweiler[2] found osteoarthritic changes in cervical spines in 67% of 3,700 subjects aged 20–70 years.

The prevalence of these changes in the cervical spine in such a high percentage of people over 40 years of age is therefore of paramount interest to clinicians who have to deal with patients who exhibit symptoms related to the neck, head, chest, shoulder, arms, hands and fingers, and sometimes also to the legs.

ANATOMICAL CONSIDERATIONS

The cervical spine with its 7 vertebral bodies and associated intervertebral discs and posterior elements, encloses the cervical spinal cord, the nerve roots and the 2 vertebral arteries with their accompanying sympathetic nerves. As a result of the constant and frequent movement of the cervical spine in daily life, it is small wonder that so many people in middle age show evidence of wear and tear in the cervical region. The anatomical sites affected in this degenerative disorder of the cervical spine, are:

Anteriorly: There is degeneration of the intervertebral disc which leads to disc protrusion or anterior or posterior osteophytes around the margins of the vertebral bodies. The posterior osteophytes may be in the midline posteriorly or situated laterally in the vicinity of the unco-vertebral joints of Luschka.

Posteriorly: Because of the disc degeneration in front, the intervertebral facets are involved in that their alignment is disturbed. There is therefore incongruity of their articular surfaces and this may lead to osteophyte formation along their margins. The intervertebral foramina are thus encroached upon in front by the protruding intervertebral disc, or nucleus pulposus, and also by the marginal osteophytes either in the midline or laterally. From behind these foramina are narrowed by the projecting osteophytes from the intervertebral facets. As a result of these pathological changes, we get the following secondary effects:

(*a*) Nerve root compression in the intervertebral foramen.

(*b*) Cord compression.

(*c*) Compression of the vertebral artery and its accompanying sympathetic nerve fibres.

SYMPTOMS

Briefly, the symptoms can be described according to the tissues affected by these pathological changes in the cervical spine.

Due to Disc Degeneration:

1. Stiff neck syndrome.
2. Diminished movements at the involved segment of the cervical spine and increased movements at the segments above and below the involved segment.
3. Loss of normal cervical lordosis.
4. Pain in the neck.

Due to Nerve Root Compression:

1. Pain in the neck.
2. Pain in the chest (often confused with coronary thrombosis).
3. Pain in the shoulder.
4. Pain in the arm.
5. Pain in hand or fingers.
6. Sensory disturbances in the upper limbs or chest.
7. Reflex disturbances in the upper limbs.
8. Motor power disturbances in the upper limbs.

Due to Vertebral Artery Compression or its Accompanying Sympathetic Nerve Fibres:

1. Headaches, either occipital or retro-ocular.
2. Dizziness or blackouts.
3. Vascular disturbances. Vasomotor or trophic lesions in the fingers.
4. 'Shoulder-hand syndrome'.
5. Horner's syndrome.

Due to Cord Compression:

1. Motor, sensory or reflex disturbances in arms or legs.
2. Disturbances of micturition or defaecation or of sexual functions.
3. Symptoms resembling amyotrophic lateral sclerosis.
4. Brown-Sequard syndrome.

RADIOLOGICAL FEATURES

Some or all of the following radiological changes may be present:

1. Loss of normal cervical lordosis.
2. Narrowing of the intervertebral foramina, or intervertebral disc spaces.
3. Osteophytes, either on the anterior surfaces or the posterior surfaces of the vertebral bodies or on the margins of the articular facets.
4. Subchondral sclerosis of the adjacent margins of the vertebral bodies.
5. Motion studies of the cervical spine in flexion or extension may show abnormal mobility with subluxation at various levels.
6. Myelograms may show protrusions into the spinal canal.
7. Discograms may show degeneration of the intervertebral disc.
8. Tomograms may show up the projecting osteophytes more clearly.

It is emphasized and generally accepted that most of the aforementioned symptoms and signs caused by cervical degenerative arthritis, except those due to frank compression of the spinal cord, are capable of being relieved in about 75% of cases by some form of conservative treatment, e.g. drugs, injections, physiotherapy, postural exercises, neck traction, braces, cast immobilization, manipulation, deep X-ray therapy.

However, we are concerned with the other 25% who are not relieved at all, and also those temporarily cured patients who suffer frequent relapses of such intensity that they are constantly being incapacitated. These patients are eventually discarded onto the medical scrapheap and are told 'to learn to live with their disability'. This exhortation has been justifiable on many occasions in the past because operative interference by the posterior laminectomy route has been fraught with great dangers. Also, the technical difficulties encountered in removing ruptured cervical discs and osteophytes by the posterior approach has, to a large extent, been the cause of the poor results obtained by this operation. In view of these difficulties and in view of these poor results, the anterior approach for fusion of the cervical spine should seriously be considered for those patients who have not obtained relief by other well-tried methods, either conservative or operative.

DISADVANTAGES OF POSTERIOR APPROACH

This operation requires a posterior incision with the patient lying in a prone position. The cervical spine muscles are retracted and therefore weakened. This retraction interferes with the nerves to the spinal muscles which may lead to permanent weakness of neck movements.

The posterior supporting structures of the spine are interfered with and the supraspinous and interspinous ligaments together with the ligamentum flavum usually have to be excised. The laminae are erased and the facet joints are sometimes opened or removed. The disc is often concealed beneath the large short cervical nerve root and therefore more bone has to be removed. The nerve root has to be retracted and is often bruised, leading to post-operative interstitial neuritis with persistent pain in the arm. Large epidural veins may be injured and persistent bleeding may obscure the operation field. Post-operative haematoma and fibrosis may result in permanent neurological deficit due to constriction of the nerve roots. Occasionally the osteophyte or disc may be situated centrally and severe traction on the cord may lead to serious symptoms. A transdural approach may even be required, with further attendant dangers to the spinal cord. If the osteophytes or protruded disc are situated in a very lateral position, they may be overlooked or may be out of reach, leading to persistence of symptoms. The posterior approach only allows removal of the small protruding portion of the disc, leaving behind $\frac{7}{8}$ of the disc between the vertebral bodies. Protrusion of the remnants of the disc may therefore occur at some future date. Moreover, the removal of only a small portion of the disc renders the 2 adjacent vertebral bodies more unstable and a further prolonged operation for spine fusion may be necessary at some later date.

When the vertebrae are fused by the posterior approach, it may be necessary to lay grafts across 3 laminae, whereas only one disc space was involved. In anterior fusion only the affected vertebrae are fused. Sometimes, by the posterior approach, several laminae are removed and it is then difficult to fuse the spine posteriorly because of lack of bony contact for the graft. After an operation by the

posterior approach, the after-treatment requires prolonged bed-rest, probably from 3–6 weeks in a cast and then a further 3–6 months' immobilization in a spinal brace.

ADVANTAGES OF THE ANTERIOR APPROACH

The anterior approach is done with the patient lying comfortably in a supine position. The anterior aspects of the vertebral bodies of the cervical spine are exposed through the front of the neck via normal tissue planes without injuring or weakening the posterior cervical muscles.

The actual site of pathology can be visualized directly and dealt with. The exposure is excellent, without any bleeding into the spinal canal. The entire intervertebral disc space is exposed and the disc is removed together with any anterior or posterior osteophytes. By removal of the entire intervertebral disc together with osteophytes, the nerve roots and cord are decompressed. There is no trauma or traction of nerve roots, dura or spinal cord. The posterior muscles, ligaments and laminae and facets which control the stability of the cervical spine, are not interfered with. Spine fusion can be obtained rapidly by wedging a bone graft between the denuded vertebral bodies. The bone graft is under compression and early union is ensured, whereas in fusion posteriorly the bone graft is under tension and fusion takes many months to occur.

Moreover, the bone graft by the anterior approach can be wedged in such a manner that the intervertebral foraminae posteriorly are enlarged. This is not, however, always a permanent feature, as the bone graft becomes slightly absorbed.

The convalescence after an anterior exposure only requires the patient to remain in bed for 2 or 3 days, and in hospital for 7 days without plaster casts or braces. This is one of the most important and valuable contributions of this operation.

INDICATIONS FOR ANTERIOR FUSION OF THE CERVICAL SPINE

1. Cervical disc degeneration from the 2nd cervical to the 7th cervical level, with or without disc prolapse or osteophyte formation, causing symptoms not responsive to conservative treatment.

2. Traumatic subluxations, dislocations or fracture-dislocations of the cervical spine which cannot be maintained by other methods.

3. Instability of the cervical spine following previous extensive laminectomy.

4. To provide stability of the cervical spine before contemplating posterior laminectomy over several segments.

5. Salvage operations for failed fusions previously done by the posterior approach.

6. For excision of neoplasms and tuberculosis involving the vertebral bodies.

7. To stabilize segments of the cervical spine in congenital and paralytic conditions.

SURGICAL TECHNIQUE

The objects of this operation are:

1. To overcome the disadvantages of the posterior cervical approach mentioned above.

2. To prevent mechanical irritation of neural and vascular tissues by bony spurs and degenerative discs.

3. To render the cervical spine stable and to prevent excessive movements which tend to constrict its various bony canals.

Under general anaesthesia and careful endotracheal intubation, the patient is placed in the supine position. If there is marked instability, gentle nasal intubation is employed. A sand bag is placed behind the neck to support the cervical spine and the head turned slightly to the right. The incision is transverse in a normal skinfold of the neck and is usually made at the level of the cricoid cartilage, i.e. the level of the 6th cervical vertebral body.

If higher levels have to be fused, the incision may be made about a finger's breadth above this level, or if lower levels have to be fused, this incision may be made a finger's breadth below the cricoid cartilage.

The incision commences (Fig. 1A) in the mid-line and is about 3–4 inches long, crossing the anterior border of the sternomastoid muscle. Before making the incision, the subcutaneous tissues may be infiltrated with Novocaine and Adrenaline to prevent skin and subcutaneous oozing.

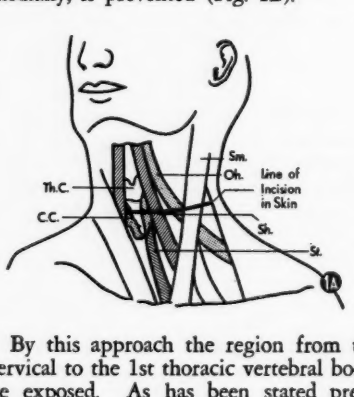
After the skin incision has been made the anterior jugular vein with its transverse anastomosis is either retracted or cut and tied. The platysma is cut in the same line as the skin incision or may be cut vertically to give a better cosmetic result. The sternomastoid muscle is retracted laterally and the strap muscles, sternohyhoid and sternothyroid, are retracted towards the mid-line. The pretracheal fascia is incised longitudinally, and a plane of cleavage between the carotid sheath laterally, and the trachea and oesophagus medially, is developed with the finger.

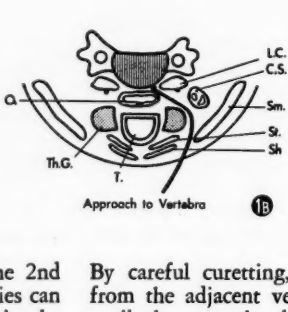
If the omohyoid obstructs the field, it is retracted downwards or may even be cut cross. The superior thyroid vessels and middle thyroid vein are sometimes found to be large when

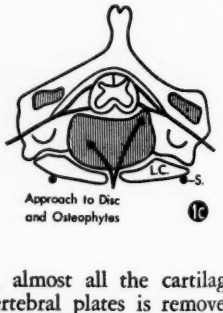
working in the upper part of the wound and may have to be tied and cut.

The trachea and oesophagus are gently retracted to the right by a blunt-blade hand retractor, and the carotid sheath is gently retracted to the left with the fingers or with another blunt-blade retractor.

The assistant should occasionally release pressure on the retractor so as not to interfere with blood flow through the vessels in the carotid sheath. The vertebral bodies can now be palpated through the prevertebral fascia. By incising this fascia directly in the mid-line in a longitudinal direction, the longus colli muscles running vertically in front of the bodies of the vertebrae are exposed. The interval between these muscles in the mid-line is developed and the blades of a self-retaining retractor are slid under these muscles and they are retracted sideways. In this manner the sympathetic fibres on the superficial surface of the longus colli muscles are avoided, and injury to the carotid sheath laterally and the oesophagus and trachea medially, is prevented (Fig. 1B).







By this approach the region from the 2nd cervical to the 1st thoracic vertebral bodies can be exposed. As has been stated previously, the skin incision level can be varied slightly if the upper or lower of these levels need exposure, or a longitudinal skin incision along the anterior edge of the sternomastoid muscle may be employed.

The level of pathology can now be determined by comparing the X-rays with the site of the anterior osteophytes on the vertebral bodies, if they are present; but to corroborate this it is advisable to place a marker, such as a needle, in one vertebral body or disc space and to take a lateral X-ray view of the cervical spine. The carotid tubercle or the cricoid cartilage, which are usually opposite the body of the 6th cervical vertebra, are not sufficiently accurate landmarks, especially when higher levels of pathology are being attacked. When the required level of pathology has been accurately determined, and the disc to be removed has been identified, a rectangle of tissue almost the entire width of the vertebral body is excised with a sharp scalpel. This rectangle of tissue consists of a portion of anterior longitudinal ligament and the superficial layers of the annulus fibrosus.

The degenerated intervertebral disc is now exposed and the material between the vertebral bodies is easily removed by means of pituitary forceps. The cartilage plates of adjacent vertebral bodies are then scraped away with a sharp edged curette. This may be difficult if there is marked subchondral sclerosis. The use of an osteotome or a chisel is definitely debarred for fear of jarring the cervical spine and its neighbouring structures. A small trephine attached to a brace may be used to commence the removal of the sclerotic plates, and thereafter sharp spoons or curettes are again employed.

At this stage bleeding from bare bone occurs and the use of suction is mandatory. By careful curetting, almost all the cartilage from the adjacent vertebral plates is removed until the posterior longitudinal ligament can be seen in the depths of the cavity. The slightly curved blade of a MacDonald's blunt dissector is gently introduced and the posterior margins of the vertebral bodies above and below can be determined. Posteriorly projecting osteophytes can then be carefully spooned out with a small curette and any remnants of disc in the postero-lateral recesses can be removed in a similar manner by means of small-sized pituitary forceps.

Bleeding, if excessive, can be controlled by gauze packing or Gelfoam.

The patient's neck is then slightly extended by the anaesthetist and the cavity thus created between the vertebral bodies can be measured. A block of bone is removed from the iliac

crest (or from the bone bank) consisting of cancellous bone surrounded on 2 or 3 sides by cortical bone. This bone graft is inserted into the intervertebral space with the cancellous surfaces against the upper and lower vertebral bodies. It is gently tapped into place so that its anterior surface is slightly countersunk under the anterior vertebral margins. The anaesthetist gently flexes the head and the graft is seen to be gripped firmly.

If 2 or 3 adjacent vertebral bodies require fusion, a longitudinal slot may be cut in the vertebral bodies (Fig. 2), the discs curetted, and a rectangular piece of iliac crest or bone bank graft closely fitted into this slot.

The retractors are removed and haemostasis is secured. The medial edges of the longus colli muscles can be approximated over the graft by 2 or 3 stitches. The cervical soft tissues and muscles are then allowed to fall back into their normal positions. To avoid haematoma formation in the vicinity of the oesophagus or larynx, a light Penrose drain may be left in the wound for 48 hours. The subcutaneous tissues are sutured and the skin is then closed using silk sutures or clips.

POST-OPERATIVE TREATMENT

Post-operative convalescence is singularly uneventful. Because the muscles supporting the head and neck have not been interfered with, the patient can be allowed to sit up in bed on the 2nd day and be allowed out of bed on the 3rd day. On the 4th day walking is permitted and the clips are removed from the skin wound. The patient can usually leave the hospital on the 7th day. No supporting brace or appliance is necessary if only one level has been fused, because vertical compression of the graft is desirable for early union. If more than one level has been fused, a light metal cervical support may be necessary.

CASE REPORTS

1. *Mrs. S. R.*, aged 37 years, was first seen in March, 1957. At that time she was complaining of pain in the neck and down the right arm for the previous 8 years. There was no history of injury to the neck or arm. The pain in the neck was constant and radiated into the back of the head and down into the right shoulder and the right arm as far as the right index and middle fingers. These fingers often felt numb. The right hand felt weak and she frequently dropped plates and cups. Occasionally she had an itching sensation in the right thumb. She was referred for physiotherapy treatment and neck traction. She did not improve and was eventually given a cervical collar to wear. She wore this for 2 months without any satisfactory improvement and was then given a course of deep X-ray therapy to the cervical spine.

She reported back 2 years later (in February, 1959) complaining that she still suffered from pain in the neck and in the right arm. None of the previous treatments had helped her and she had recently had injections into the neck without any relief.

Fig. 2. Showing fusion graft lying on bodies of C5, C6 and C7 a few days after operation.

Only the cortical portion of the graft is visible. The cancellous part of the graft has been countersunk into a slot in the front of the vertebral bodies.

Other than a gynaecological operation 4 years before, she had had no serious illnesses or injuries.

Examination revealed marked limitation of extension of the cervical spine. There was a loss of the normal cervical lordosis. Flexion was about 75% of normal. Rotation to the right and left was about 50% of normal with pain on lateral flexion to the left and to the

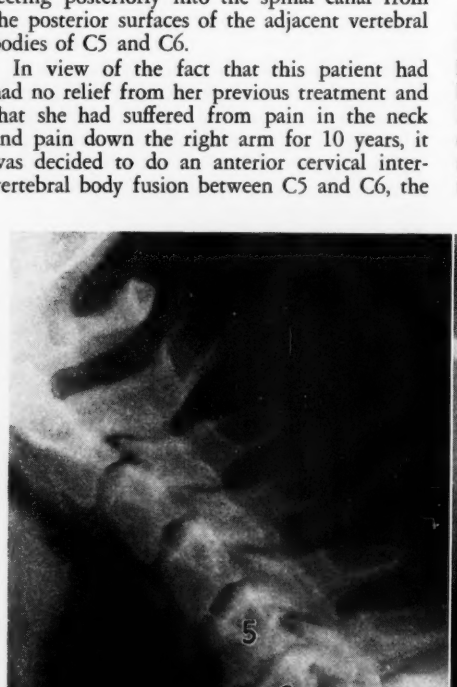
right, in the right shoulder joint and down the right arm. There was tenderness on palpation in the mid-line of the neck over the 5th cervical spinous process. There was no wasting of the arm. The arm reflexes on the right were slightly more sluggish than those on the left, but were all present. There were no objective sensory disturbances in the right arm, hand or fingers.

X-rays taken in January 1959 showed a congenital fusion of the vertebral bodies of the 4th and 5th cervical vertebrae. Motion studies of the cervical spine showed increased mobility of C3 on C4 and diminished mobility of C5 on C6. There were gross osteophytes projecting posteriorly into the spinal canal from the posterior surfaces of the adjacent vertebral bodies of C5 and C6.

In view of the fact that this patient had had no relief from her previous treatment and that she had suffered from pain in the neck and pain down the right arm for 10 years, it was decided to do an anterior cervical intervertebral body fusion between C5 and C6, the site of maximum tenderness and also the site at which there were projecting osteophytes posteriorly into the spinal canal.

On 2 March 1959 the operation was performed under general anaesthesia. A transverse incision 4 inches long was made in a normal skin fold on the left side of the neck. The anterior surfaces of the cervical vertebral bodies were exposed by the method described. The disc spaces between C4, C5 and C6 were easily identified because the bodies between C4 and C5 were congenitally fused. The disc material between C5 and C6 was removed completely. The articular surfaces above and below were sclerotic and could not be cleared entirely of cartilage. However, they were cleared as well as possible and a small block of bone was taken from the right anterior iliac crest and wedged into the space. The wound was closed in layers.

Post-operatively the cervical spine was not immobilized at all. The patient was allowed up on the third day and discharged from hospital on the 12th day without any spinal brace or other support. When seen a month later all the pain in her neck and arms had disappeared. She was extremely pleased that she had had the operation because it was the first time for 10 years that she was free of pain.



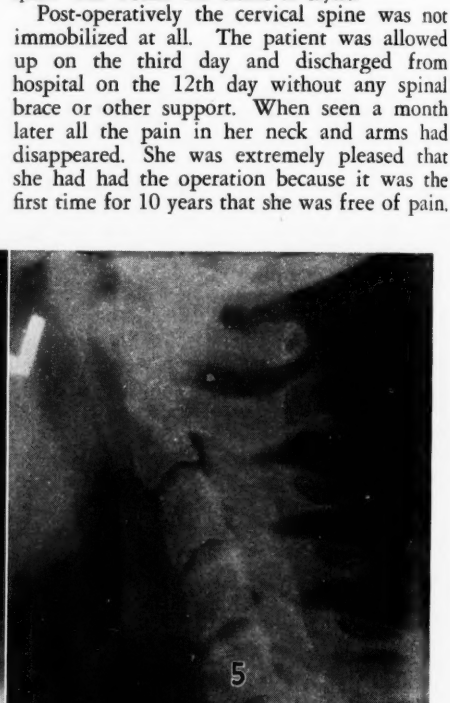


Fig. 3. Before operation, showing disc degeneration between C5 and C6 with anterior and posterior osteophytes.

Fig. 4. After operation. Same case as illustrated in Fig. 3, showing graft between the bodies of C5 and C6 three days after operation.
The skin clips in the operation wound are seen *in situ.*

She felt, however, that when swallowing there was a lump in her throat and she had to swallow frequently because of the presence of phlegm. She had no difficulty in eating. The feeling of excessive phlegm in her throat lasted about 4 months and eventually disappeared completely. This was probably due to the formation of a small haematoma in front of the bone graft.

When last seen 9 months after the operation she still had no pain in her neck and no pain in her arms. She occasionally had fibrositic pain in her shoulder blades but this was, she said, of no consequence.

2. *Mr. B. G.*, aged 34 years, stated that he had sustained a severe neck injury when he was struck at the base of his head by a fall of rock 8 years before. Ever since that time he had frequent attacks of pain and stiffness in the neck. Conservative treatment had given no permanent relief. A week before his admission he complained of pain in his neck whilst swinging a golf club. It was an acute searing pain which radiated into his left shoulder blade. He found that he could not look to the left comfortably and that coughing and sneezing aggravated the pain in the neck and in the left shoulder.

Examination revealed that he had a torticollis to the right and marked tenderness over the lower cervical spine. Flexion of the cervical spine was 50% of normal. Extension was completely absent. Rotation to the right was full. Rotation to the left was completely absent. Lateral flexion to the right and the left was extremely limited on both sides. There were no objective neurological signs in the upper or lower limbs.

X-rays taken on 29 December 1959 showed an advanced disc lesion present with disc degeneration between the 5th and 6th cervical vertebrae and the presence of anterior and posterior osteophyets (Fig. 3). The disc space was considerably narrowed. There were marginal osteophytes encroaching on the intervertebral foramina posteriorly at this level. Osteoarthritic changes were present in the joints of Luschka at the C5–C6 level.

Because this patient had had recurrent pain for 8 years, he was willing to undergo any form of operative treatment so that he could be relieved of this discomfort and also of the recent acute attack which had not yet subsided and which gave rise to pain in the neck as well as in the shoulder.

Operation was performed on 25 Jaunary 1960 under a general anaesthetic. A transverse incision was made in a normal skin fold on the left side of the neck at the level of the cricoid cartilage. The sternomastoid was retracted laterally and the strap muscles were retracted medially. The carotid sheath was then retracted laterally and the oesophagus and trachea were retracted medially. The anterior surfaces of the vertebral bodies of C5 and C6 were exposed by retracting the longus colli muscles on either side. A large anterior osteophyte between C5 and C6 was found and nibbled away. This was obviously the site of the lesion and no X-ray localization in the operating theatre was necessary. The disc material was removed with a rongeur. The upper surface of C6 and the lower surface of C5 were rawed down to bleeding bone with a sharp curette. A block of cancellous bone-bank human bone preserved in ether was impacted between the vertebral bodies so that the anterior surface of this block lay below the anterior edges of the vertebral bodies. The wound was closed in layers and a Penrose drain was left down to the vertebral bodies to prevent haematoma formation. The skin was closed with clips.

This patient was allowed up out of bed on the 3rd day. (Fig. 4). The Penrose drain had been removed the day before. The clips were removed on the 5th day and he was allowed to go home on the 7th day.

When seen 2 months later he had almost full rotation of his cervical spine. His extension was full. He felt very satisfied with the operation and stated that he could now definitely rotate his head far more than he could during the previous 8 years. He had no pain in the neck and no pain in the shoulder.

COMPLICATIONS

The only complications noted so far have been slight difficulty in swallowing for 2 or 3 days and also the development of a small haematoma which gradually became organized and disappeared.

One patient (as mentioned) had the peculiar sensation of too much phlegm in her throat and had to swallow frequently. This was probably due to the organizing haematoma. These symptoms eventually completely disappeared.

CONCLUSIONS

Degenerative cervical spine lesions, with or without osteophytes, give rise to symptoms of pain in the head, neck, chest, scapulae, shoulders, arms, hands and fingers. Mechanical instability of the cervical spine as a result of trauma, previous operations, infection, muscular paralysis, congenital abnormalities, etc. may also cause similar symptoms.

An operation designed to fuse the affected or unstable vertebrae by placing a bone graft anteriorly between the vertebral bodies has been described. This operation is technically simple, less time consuming, less dangerous and less complicated than the operation by the posterior approach. Moreover, post-operative convalescence is surprisingly short and uneventful.

In view of these numerous advantages, this type of operation may justifiably be offered to patients suffering from the effects of cervical disorders which have not responded to conservative measures.

SUMMARY

The technique of anterior cervical interbody fusion is described. The disadvantages of the posterior approach compared with the advantages of the anterior approach are indicated. Case reports are presented.

Cloward[1] reported anterior cervical spine fusion operations on 47 patients with complete relief in 42, and improvement in 5.

Smith and Robinson[6] also described a series of 14 cases operated upon by the anterior cervical route with complete relief in 9 and improvement in 4 cases.

My thanks are due to Mr. M. Lautre and Mr. L. Stein for their assistance at these operations, and to the Witwatersrand University Department of Medicine for the photographs of the X-rays.

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THE ACUTE ABDOMEN

IN INFANTS AND CHILDREN

WILFRED KARK, F.R.C.S.
Johannesburg

The acute abdomen in infants and children remains a major problem in clinical practice. Many of the older teachings require re-statement and re-learning, and new fields of diagnosis and management are constantly developing and evolving.

The ever-widening curriculum of the modern medical student demands such crowded hours that many subjects suffer from a reduction in the time made available for their study; it is particularly unfortunate that the study of children's surgery in general has been so conspicuously affected. In particular, the study of acute surgical conditions in children is almost a closed book to many modern students because the cases usually arrive at hospital and are treated at times when the student is otherwise engaged. The danger is a climbing mortality and morbidity.

Knowledge of acute abdominal conditions in adults cannot be applied directly to similar conditions in children. Quite apart from some major differences in the range of conditions that occurs in children as compared with adults, there are significant differences, both from a clinical and a therapeutic point of view, in the same condition at different ages.

In many of these young patients it is not possible to get an adequate story or proper answers to direct questions; so this very important lead to the diagnosis has to be waived. In general, liaison with children and the establishment of *rapport* is much more difficult than it is in the adult.

In addition to these clinical difficulties, acute abdominal conditions are more serious in children than they are in the adult; their progress is more rapid and the consequences of an upset in fluid and electrolyte balance and the effects of toxaemia are much more lethal.

In the course of conducting a practice involving children, it becomes very obvious that a special mental attitude is required. The approach and handling of children requires a carefully cultivated discipline; perhaps the greatest requisite is patience, and close to this is a properly systematized physical examination. From the pathological aspect, the main

discipline required is one of recognition of the rapidity and severity of advance, and therefore the great dangers of prolonging observation in anticipation of more definite evidence of the condition.

The clinical problems and conditions are most conveniently classified into 4, roughly defined age-groups:

neonatal; 1-24 months; 2-5 years; and over 5 years.

NEONATAL GROUP

The commonest condition is *intestinal obstruction,* most often of a high, small bowel type, but it may be at any level down to an imperforate anus. The causes are numerous: atresia and stenosis, malrotations, mesenteric cysts, annular pancreas, Meckel's diverticulum, meconium ileus; all these conditions give rise to symptoms of intestinal obstruction within the first day or two of birth. The outstanding sign is vomiting. This is repeated and usually contains bile. There may be no other clinical evidence of intestinal obstruction—until it is too late to hope for much good to be achieved by surgical treatment.

Imperforate anus may not produce symptoms for several days after birth; yet it should be regarded as an acute abdominal emergency calling for early treatment. Its recognition is easy if routine examinations are done on the newly born.

Congenital hypertrophic pyloric stenosis. Outside of Johannesburg, this is a very common surgical condition. The symptoms are those of high obstruction, with vomiting beginning as early as the end of the second week, but more commonly in the third week of life. The vomiting soon becomes projectile and occurs whenever the infant has anything to drink. There is no bile in the vomitus as the obstruction is proximal to the duodenum. The child remains hungry and is eager for its food. Dehydration and electrolyte imbalance are early manifestations.

Physical examination usually shows reversed gastric peristalsis, and also the pyloric tumour. A small feed will often render both these physical signs more apparent.

Diaphragmatic hernia often presents a neonatal clinical triad of cyanosis, dyspnoea and vomiting; X-rays clinch the diagnosis. Successful surgical repair is more likely if the operation is done within the first 48 hours of life, and disadvantages accumulate if operation is postponed. An appreciable number of cases have an associated malrotation of the gut.

Peptic ulcer is being increasingly found in infants and children. Complications are rare, but both perforation and haemorrhage may call for surgery in the infant, while obstruction is more apt to complicate the condition in older children.

There are a number of conditions affecting, and occurring about, the *umbilicus* in the newborn that require urgent surgical management. The commonest of these is *omphalitis,* which may be a mild cellulitis, or an abscess, or a severe spreading cellulitis with necrosis. The mildest of these infections may be responsible for later portal obstruction and portal hypertension; the most severe are often fatal.

More rarely, *cysts and fistulae due to a urachal remnant or a persistent vitelline duct* occur and carry with them a danger of infection, both extra- and intra-peritoneal. It is this danger which makes them urgent conditions and calls for early surgical treatment. *Exomphalos,* even more rarely seen, also requires early surgery to prevent infection and peritonitis.

AGE GROUP 1-24 MONTHS

In this group intestinal obstructions are the common acute abdominal conditions. The commonest is *intussusception,* most often occurring at the 4–9 months period of life. The classical syndrome of intermittent bouts of colic, the vomiting, the red currant jelly stools, and the well-being of the infant during remissions until the disease is advanced, together with the physical signs of the sausage-shaped tumour and the rectal findings, usually make the diagnosis easy and certain. The occasional 'chronic' case may give difficulty and may require radiological assistance for its diagnosis. Early operation is still the best form of treatment with the highest record of successes.

It is also in this age group that *incarceration as a complication of inguinal hernia* occurs most often. Its highest incidence is during the first 6 months of life, then it diminishes progressively to become a rarity after the age of 5 years. Occasionally the condition advances to strangulation, particularly of the ovary. Incarceration may be the first evidence of the existence of a hernia. The swelling is painful and tender and vomiting is usual.

Primary peritonitis, a condition which is becoming less common, has its highest incidence from 1-4 years of age. Its onset with general abdominal pain, vomiting, high fever (usually more than 102° F.) and symmetrical, generalized, abdominal tenderness and rigidity, may

lead to a correct pre-operative diagnosis. However, the large number of diagnostic errors (estimated at about 1 in 3) points to the deduction that many cases of secondary peritonitis might be missed and that therefore laparotomy is almost always indicated.

Another cause of obstruction that has its highest incidence in this age group, is *reduplication of the alimentary tract.* The delay in the onset of obstruction is probably due to the time it takes for these reduplicated portions of the alimentary tract to become sufficiently distended with secretions to exercise pressure on the bowel itself or on the vessels of the bowel. While obstruction is the commonest manifestation, massive haemorrhages from the bowel may also occur.

In this age group, too, obstructions caused by *swallowed foreign bodies and undigested food,* have their greatest incidence. At older ages, an additional obturation type of obstruction, from a *mass of worms,* is quite common in the rural population.

About half of the complications of Meckel's diverticulum present in this age group. While massive haemorrhage is the commonest symptom, other acute manifestations, such as inflammation and peritonitis, and obstruction by a compression, by bands, by kinking, by volvulus and by intussusception, can also occur.

The presence of a *tumour in the flank* should be regarded as an acute abdominal condition. Such a tumour is most commonly a Wilm's embryoma or a neuroblastoma, and the sooner such tumours are surgically extirpated, the more hopeful is the chance of the child's survival. Flank tumours are included in this age group because they most frequently come for treatment during this period; however, it is probable that routine examinations at an earlier age would bring them to notice and to treatment at a much more favourable stage of development. The cure rate for these tumours (when treated within the first 12 months of life) is 80%, but only 47% during the next 12 months.

AGE GROUP 2-5 YEARS

It is worth noting that about one third of the cases of intestinal obstruction arising from malrotation and also from congenital stenosis occur in this age group.

Appendicitis enters the field of common acute abdominal conditions during these years. It is rare in the first year of life, uncommon in the second year of life, and has its peak incidence from the 5th year.

As already mentioned, most cases of *primary peritonitis* occur at this age. In general, the 2-5 year age-group may be considered an overlapping stage. Most of the conditions affecting the earlier age group up to 2 years also present after 2 years; and most of the conditions which have their greatest incidence after 5 years of age also present at a somewhat earlier age.

AGE GROUP OVER 5 YEARS

Appendicitis is the commonest acute abdominal condition. The clinical picture often differs from that found in the adult. Its course is usually rapid and its effects are dangerous. More cases present irregular clinical features than with those usually described in textbooks. This is so marked that any abdominal pain, associated with, or followed by, nausea and vomiting, should be regarded with suspicion.

The localization of the pain varies from case to case. Most commonly it begins centrally and radiates to the right iliac fossa, almost as commonly, it begins and remains in the right iliac fossa. It may begin about the centre of the abdomen and not become more definitely localized for a considerable period. Hypogastric and supra-pubic localizations are quite common. Uncommon situations are in the right hypochondrium and in the right loin.

Of the physical signs, *tenderness* is almost invariably present, although it may require a bimanual examination to reveal it; its situation also varies. In about 8 of every 10 cases, tenderness will be present in the right iliac fossa, but in 2 of 10 cases, tenderness will be situated at some other site, most often in the pelvis (and found on rectal and bimanual examination), in the centre of the abdomen or around towards the right loin.

The sign of *rigidity* is often difficult to find in children, and requires special techniques. It should be sought as the first item in the palpation of the abdomen so as not to antagonize and frighten the child by causing pain. It requires the gentlest pressure across the grain of the muscle and routine comparison of symmetrical areas on either side of the midline. It should not be regarded as a *sine qua non* of diagnosis, but its presence is of the highest diagnostic importance.

The ' positive ' features of the clinical picture should lead to a diagnosis of appendicitis, and various ' negative ' clinical features should not be permitted to alter it. The clinical aspects re-

ferred to as 'negative' most often arise from urinary and bowel symptoms. Urinary symptoms appearing in the course of an appendicitis are much more common in children than in adults. In about one in every 10 cases, one or more of the following occur:

Increased frequency of micturition;

Burning in the urethra; supra-pubic or right inguino-hypogastric pain during micturition; and urgency;

Occasionally the urine contains albumin and rarely blood.

Of the bowel symptoms, diarrhoea with mucus is more common than constipation, but both have been noted with sufficient frequency to justify the warning that the diagnosis of appendicitis should not be avoided on account of their appearance.

The picture of an abdominal emergency at this age period may be given by *torsion of the testis* or one of its congenital appendages. The diagnosis is readily discovered during the course of routine examination.

At this age, too, children become more vulnerable to *blunt injuries*, mainly because of traffic accidents but also arising from their more strenuous physical activity in sport and gymnastics. Pain and tenderness are the outstanding manifestations, and it is their degree, which is all important and which requires such careful assessment to make a diagnosis. Signs of shock and the sign of rigidity may be delayed and they should not be awaited. It is often a matter of considerable surprise to find the very gross lesions resulting from blunt trauma of the abdomen in children: not only pulverization of a solid viscus, especially of the spleen, but also extensive tears of mesentery and lacerations of the gastro-intestinal tract, at fixed points such as the duodenum and the commencement of the jejunum or of the ileo-caecal region, as well as of the 'free' loops of the small bowel, in which event the main symptoms and signs are often referred to the left side of the abdomen where they remain for some appreciable time. Referred pain, i.e. shoulder pain, and rebound tenderness are fairly common, but a 'silent' abdomen on auscultation, shifting dullness, and diminution of liver dullness are often delayed and should not be regarded as necessary for the diagnosis and appropriate surgical exploration.

Various forms of *lymphadenitis* enter the field covered in this paper on account of their own occasional intrinsic need for urgent surgical treatment and also because they may cause confusion in the diagnosis of other acute emergencies in the abdomen.

Iliac adenitis is probably secondary to primary infection about the ano-rectal canal or the lower limb, although often a primary focus is not to be found. A limp is a common herald of the condition which later gives pain in the iliac fossa, mainly somewhat inferiorly towards the inguinal ligament. Tenderness may be found only on deep palpation. Localization is most readily made on high rectal and bimanual examination, and the diagnosis is further suggested by the absence of nausea and the presence of high fever and marked leucocytosis. Progress to abscess formation calls for surgical drainage.

Acute, non-specific, mesenteric lymphadenitis is even more confusing in the diagnosis because it so closely mimics appendicitis. Aids in the differentiation are:

Adenitis is usually associated with respiratory infection;

The abdominal symptoms often begin as general abdominal colic, quite severe, but with remissions during which there is remarkable freedom from pain;

Restlessness is common during the attacks of colic;

Tenderness is rather higher and more medial in position than it is in appendicitis, and it is also slighter and more vague;

There is an absence of rebound tenderness;

The sign of shifting tenderness (i.e. the site of tenderness differs in the supine from that in the left lateral position), when present, is significant;

Rigidity of the abdominal muscles is often present, but it tends to relent in the course of a patient examination;

Not much help can be obtained from a white cell count, as the tendency is for a short, temporary rise to occur during the first 24 hours and then a fall to the 10,000 level for the next few days; whereas in appendicitis, the tendency is for a gradual and progressive rise in the count.

There will often be considerable doubt about the diagnosis, and under such conditions it is far safer to operate, because appendicitis is very common and the risks of laparotomy are far fewer than the risks of delay.

Tuberculous mesenteric adenitis may, at times, present a picture of an acute abdomen. Sudden, sharp abdominal pain, most often in the right iliac fossa, can result from a secondary infection of a tuberculous gland in the mesentery. The gland mass is usually palpable. Sometimes such masses are multiple and, in non-tender areas, their craggy contour will be indicative. The white cell count does not rise, and the abdominal wall remains lax.

Other more uncommon acute conditions also occur: obstruction of the ileum may arise from adhesions to a tuberculous gland; and, lastly, a fairly acute form of tuberculous peritonitis may occur.

Cholecystitis in children is a great rarity, but cholelithiasis is, by comparison, not uncommon.

It is usually due to a haemolytic anaemia which demands primary attention. However, the pigment stones occasionally cause obstruction in the biliary passages and call for surgical treatment.

SUMMARY AND CONCLUSION

While this brief survey does not pretend to be exhaustive, it aims to indicate the extent, the importance and the dangers of acute abdominal emergencies in infants and children. The range of symptoms of these conditions is restricted. The signs are also limited and they demand assiduous and patient seeking. In most cases, a diagnosis can be made with a fair degree of confidence and precision; others can only be given a provisional label, sufficiently firm to call for surgical exploration when the condition can be dealt with and corrected and the more academic question of confirmation of the diagnosis can be settled.

The progress and course of these acute conditions is a rapid advance to a dangerous state; and the distressingly high mortality is capable of considerable improvement provided that:

i. There is a greater awareness of the existence, and the common incidence of the conditions that occur;

ii. There is a keener appreciation of the criteria for diagnosis, in general, if not in particular terms;

iii. That the cases be submitted to early, proper and adequate surgical and ancillary management.

MILLI-OSMOLS MADE EASY

SOME FUNDAMENTAL BIOCHEMICAL AND CLINICAL CONSIDERATIONS

WITH PARTICULAR REFERENCE TO PAEDIATRICS

S. LEVIN, M.B. (RAND), M.R.C.P. (EDIN.), D.C.H.
Johannesburg

'Away with all such childish stuff;
Bring chemists to the fore.
The ion now is all the rage;
We listen to the modern sage
With all his latest lore;
And if the baby fret or cry,
We'll see just how the ions lie.'

*Ruhräh.**

By 'childish stuff' John Ruhräh, paediatric historian, meant mere clinical evaluation. But in fact, in this, the penultimate stanza of his famous poem, he was poking fun at the excessive use of biochemistry in paediatrics.

Yet a knowledge of biochemistry is quite indispensable for the intelligent practice of modern paediatrics. The clinical essentials of the subject are not difficult to master, and have been summarized in a previous paper entitled *Milli-Equivalents Made Easy*.[1] It is still true to reiterate that the average medical reader, noting a paper on fluid and electrolytes, will find rapid mention of ions, osmols and valencies, and will shudder and sigh, wonder what medicine is coming to, and will proceed, disheartened, to the next paper.

It has been noted, rather facetiously, that there are 3 forms of medical papers published today:

1. Bread and butter, down to earth clinical articles.
2. 'Whither?' contributions. (*Whither Pathology?*; *Endocrinology at the Cross-Roads*; *The New Paediatrics*).
3. 'Hexose-6-phosphate' papers. These are quite unintelligible to the vast majority engaged in clinical practice.

Consideration of ions, osmols, *et al.* falls into the latter category. They are frequently imagined to be esoteric and incomprehensible. In fact, this is not so. The essentials of the subject are really rather straightforward, and are only complicated to those who have a psychological block about the whole matter.

* *Cited by* J. T. Lanman in *Modern Trends in Infant Nutrition and Feeding*, 1952. New York: Sugar Research Foundation.

[*Note*: The references will be published at the end of the concluding part of this article.—*Editor*.]

Though this paper is shamelessly 'hexose-6-phosphate,' I would hesitate to explain without further ado that milli-equivalents (mEq.), milli-mols (mM.) and milli-osmols (mOsm.) are to be defined in terms of atomic and molecular weights and their valencies. Such explanations are certain to court disaster; they will frighten off even the very bravest readers. A much more gentle introduction to the subject is needed.

It must be stated quite firmly that these biochemical terms and conceptions are here to stay and will find increasing use and value in the future. The better understanding of fluid and electrolyte alterations in various disease states is one of the really outstanding advances in medicine since World War II. It is probable that the judicious use of salt and water has been responsible for saving more lives than has any other single therapeutic factor. Such a massive weapon for therapy, and for danger, needs to be understood. However, one must guard against a too rigid and mathematical concept of biochemistry. There is a good deal of truth in Bakwin's remarks:

> 'I look forward to the day—not too far distant I hope—when the daily balancing of fluid and electrolyte requirements will be viewed with the same amused scepticism with which the precise calculation of dietary needs is now regarded.'[2]

IONS, OSMOLS ET AL.

The question now arises: what is a mOsm, what significance has it, what is its clinical importance, and what is its relationship to mM. and mEq.?

A mOsm is much the same as a mEq., at any rate for ions like Na and Cl. However, in more correct definition, one would have to state the rigmarole that a mOsm is simply a mM. in solution, exerting an osmotic effect; and that a mM. is 1/1,000th part (0.001) of a mol; a mol is a gram-molecular weight, and a gram-molecular weight is the atomic or molecular weight of a substance expressed in grammes.

Now why go to all this roundabout trouble, and where does it lead us? This meandering is really very necessary. The point is simply this: chemicals, including chemicals in the body fluids, do not combine and react with each other according to their physical weights, but according to their chemical equivalents. For example, if 1.0 g. of Na ion be imagined in solution, and 1.0 g. of chloride ion added, the resultant chemical combination would not be a complete one; there would still be lots of unattached sodium ions, while all the chloride ions would have combined with sodium, and the pH of the solution would be alkaline, not neutral. Sodium ions are much lighter than Cl ions and very many more of them would be needed to make up 1.0 g. of Na ion. The atomic weight of Na is 23, that of Cl about 36. If we desired to make a complete chemical reaction between these two ions, it could be done by adding 23 g. of Na to 36 g. of Cl. It is thus clear that electrolytes combine with each other not according to equal physical weight, but according to their chemically equivalent weights. Thus 23 g. of Na is defined as 1 gram-equivalent; also as 1 gram-molecular weight, or 1 Mol (or mol). For Cl ion, 1 Mol is 36 g.; and 1 mol of Na will react exactly with 1 mol of Cl, and 1 mol of Cl will combine exactly with 1 mol of K (which is 39 g.; atomic weight 39). These 3 ions have one factor in common: they are all univalent. When considering other ions such as Ca, or phosphate, slightly different (but perfectly comprehensible) considerations apply. These will be dealt with presently.

Terms like Mol or mM. (1/1,000th part of a mol) are especially useful for expressing osmolar relationships, just as terms like Equivalent and mEq. (1/1,000th part of an Equivalent) are valuable for expressing chemical interrelationships. A Mol or an Equivalent of a substance, when dissolved in fluid, exerts an osmotic attraction and, by definition, 1 Mol of any substance within 1 litre of water has an osmotic attraction of 1 Osmol—no matter what the substance be. One Mol within 1 litre produces a molar solution. For example, 1 mol of NaCl (23+36=59, i.e. 59 g.) in 1 litre of water produces a molar solution of NaCl. In the case of sodium lactate, 1/6 molar (lactate) solutions are in common clinical use.

Terms like Mol and Equivalent deal with comparatively massive quantities and, as far as the body is concerned, terms for much smaller quantities are required. By convention we deal with 1/1,000th part of a Mol, Osmol or Equivalent, i.e. mM., mOsm and mEq.

A molar solution of NaCl (i.e. 59 g. per litre) therefore has 1,000 mM. (or 1,000 mEq.) of NaCl salt. But it must be remembered that NaCl dissociates into its constituent ions in solution, and that each ionic particle exerts a separate osmotic attraction, so that a molar solution of NaCl has 1,000 mM. (or mEq.) of Na ion plus 1,000 mM. of Cl ion, making a total osmotic force of 2,000 mOsm per litre, and equally so a *total* chemically equivalent value of 2,000 mEq. per litre (1,000 mEq. Na ion plus 1,000 mEq. Cl ion). It will be noted

that with such univalent ions, the values of separate ion, whether written as mM., mOsm., or mEq., will always be the same. With divalent ions such as calcium this does not apply, and allowances must be made for valency. For example, calcium chloride is $CaCl_2$. In solution this will break up into 3 ions, so that 1 mM. of $CaCl_2$ salt will provide 3 mOsm of ion.

A substance like calcium, or divalent phosphate ion, has available, as it were, 2 arms with which to combine with other electrolytes. Thus even though one particle or one atom of calcium exerts only one unit of osmotic force, it can yet combine with 2 particles or 2 atoms of a univalent anion. Hence calcium will have an equivalent value twice that of its osmotic value. With reference to Equivalent and mEq. values of ions, those which are divalent should be regarded as 'Siamese twins' for the purposes of chemical combination. To take the former example again, 1 mM. of $CaCl_2$ salt, when placed in solution, will provide 3 mOsm of ion (for osmotic purposes), but 4 mEq. of ion (for purposes of chemical interrelationships).

Clearly, the osmolar force of an ion in solution can be determined by dividing the number of mg. of the substance by the atomic weight, i.e.:

$$\text{mOsm per litre} = \frac{\text{mg. per litre}}{\text{Atomic Weight}}$$

The equivalent value must take valency into account, and for those ions which are divalent (twins, as it were) the mEq. value will be twice the mOsmolar value, i.e.:

$$\text{mEq. per litre} = \frac{\text{mg. per litre} \times \text{Valency}}{\text{Atomic Weight}}$$

For ions like Na, K, Cl, NH_4, lactate, bicarbonate and acetate, the valency is 1, so that mOsmolar and mEquivalent values are identical. If the chemical formula for some organic substances (e.g. sodium lactate) be known, then mM., mEq. or mOsm values can easily be calculated if one remembers the atomic weights of the ions making up the compound. As regards the common organic substances, their constituent ions have atomic weights as follows:

Oxygen = 16; hydrogen = 1; carbon = 12; nitrogen = 14.

Then the formula becomes:

$$\text{mM. of Compound per Litre} = \frac{\text{mg. of Compound per Litre}}{\text{Molecular Weight}}$$

Taking sodium lactate as an example, the formula of this substance is $CH_3CHOHCOONa$, so that its molecular weight is $12+3+12+1+16+1+12+32+23=112$. Assuming that there is 1.0 g. of sodium lactate dissolved in 1 litre of water, then

$$\text{mM. of Na lactate per Litre} = \frac{1{,}000 \text{ mg.}}{112} = \pm 8.9$$

mM. per Litre.

Thus there are about 9 mM. of Na lactate salt within the solution. This substance dissociates, so that there are 9 mOsm of Na and 9 of lactate and, both radicals having valencies of 1, there are also 9 mEq. of each, a total of 18 mEq. (or mOsm) of solute per litre. It will be noted that the terms mEq. and mOsm are reserved for the separate ions of a compound, whereas mM. is used both for single ions and also for the compound itself, be it a salt, like sodium lactate, or a non-electrolyte like urea or glucose. Non-electrolytes do not dissociate in solution, so that in such an instance, mM., mOsm and mEq. values will be identical, though the term mEq. should not be used for non-ionizing substances.

A mM. can allude to a single ion—purely by definition. If 1 mol of sodium is 23 g., then 1 mM. is 23 mg., while 1 mM. of K is 39 mg. and 1 mM. of Cl is 36 mg. One mM. of NaCl salt will then weigh $23+36=59$ mg., and this quantity dissolved in 1 litre of fluid will contain 1 mOsm of Na radical plus 1 mOsm (or 1 mEq.) of Cl ion, totalling 2 mOsm of osmotic force within the litre of fluid.

Substances like protein, glucose or urea do not dissociate (though protein is an electrolyte) and their osmotic attractions are calculated on the basis of the number of individual particles dissolved within the fluid—and no matter how large the molecules of these substances, their osmotic forces are not enhanced thereby. One atom of Na ion has exactly as much osmotic force—in solution—as one molecule of the comparatively massive glucose, or one molecule of the comparatively gigantic protein. So that even though plasma values of protein are reckoned in quantities of grammes rather than milligrammes, the total osmotic force of proteins in plasma is rather low—as can be seen from Fig. 2. Fig. 2a also indicates that the total mEq. concentration of plasma (i.e. cation + anion) is some 310 mEq./L. However, ions like Ca, Mg, PO_4, SO_4 or protein, which have valencies of more than 1, account for but a small fraction of the total mEq. value. These substances, mostly with valencies of 2 (protein has an average valency of 8) have mOsm values of but a half of their mEq. values (for reasons explained earlier) so that in calculating the total mOsm load of

plasma we get a value rather less than 300/L. In fact the mOsm load of plasma is something like 290 mOsm/L., though if we take into account the mOsm concentration of other substances dissolved in the plasma water (glucose, urea, cholesterol, creatinine, amino acids, etc.) the mOsm value can be calculated to be in the region of 300–310 mOsm/L. of plasma water. Such finesse is quite unnecessary in clinical practice and we may reasonably consider plasma to have a normal osmolar load of 300 mOsm/L.

STANDARDS OF REFERENCE

The interpretation and the treatment of disturbances of electrolyte and osmolar relationships is fraught with difficulties, not only because of our incomplete understanding of these processes, but also because of our lack of absolute frames of reference.

We may judge aberrations and needs on the basis of a patient's age, weight, rate of metabolism and surface area (expressed as square metres (M^2) of body surface) and these suggested standards may all be modified by extraneous influences such as heat and humidity. None of the standards is entirely satisfactory. After a lengthy flirtation with surface area as a frame of reference, many of the authorities are now disenchanted with this criterion and, despite a recent spirited espousal,[3] it appears that surface area will be departing from the clinical scene for reasons[4, 5] which do not concern us here. Just for the record, it may be noted that:

0.25 M^2	is roughly equivalent to	5 Kg. or	11 lb.
0.5 M^2	is roughly equivalent to	11 Kg. or	24 lb.
1.0 M^2	is roughly equivalent to	28 Kg. or	62 lb.
1.73 M^2	is roughly equivalent to	70 Kg. or	154 lb. (adult).

By far the most cogent and significant absolute basis of reference is an individual's weight. Of all special examinations and investigations ever performed on infants and children, certainly the most important single procedure is an accurate recording of the weight. There are very few infants who are so critically ill on admission to a ward that their weight cannot be recorded on entry.

Yet weight is not a foolproof background for judgment of the biochemical status of body fluids. In young infants something like 70% (80% in premature infants) of the body make-up is water. But there are fat infants and thin ones, and the fat deposits of the body are free of water and take virtually no part in daily metabolism. An obese child (whose inert fat deposits may account for perhaps a third of his total weight) requires rather fewer calories than his weight would suggest; while a malnourished baby requires proportionately more food, so that in this instance it is more accurate to use age rather than weight as a standard of reference.

Regarding dehydration, an infant rapidly losing 10% of his body weight (virtually all water loss) will be severely dehydrated, but will fare differently according to his weight. In a thin child with negligible fat stores, a 10% body weight loss will be equivalent to about a 15% loss in the body's water (the water content being about 70% of the total). However, an obese infant losing 10% of his weight (perhaps only two-thirds of it fat-free) will lose about 20% of his body's water (70% of the fat-free portion). That is why equivalent dehydration-weight loss is more serious in the fat child. To overcome this difficulty it has been suggested that the standard of reference should not be the actual weight, but the 50 percentile normal weight for that age, or an estimation of the 'lean weight' could be used. However, this is really unnecessary and even unwise, as it raises many complications; true weight will do provided one makes reasonable allowances for obvious obesity.

Another standard of reference (first suggested by Darrow as a substitute for the unsatisfactory surface area criterion) is that of metabolic turnover. Standards and disturbances could be judged on the basis of 100 calories metabolized. It was pointed out that whereas deficit therapy could be calculated on the basis of body weight, maintenance requirements depend in fact on the rate of metabolism, and should therefore be calculated on the convenient basis of 100 calories metabolized,[6] especially since this criterion is not influenced by any amount of inert body fat.

> 'The use of such a unit rather than surface area has a sound theoretic basis and does not unduly complicate practical therapy, since the pediatrician commonly thinks in terms of caloric requirements.'[7]

In this respect two points must be made:

1. Metabolism is always taking place, whether or not extraneous calories be supplied. Even if none be forthcoming enterally or parenterally, basal metabolism still occurs from a breakdown of body stores, and fluid and electrolyte requirements can still be calculated on the standard of 100 calories metabolized—for the basic caloric needs of infants (and adults) are known.

2. Granted that it is much easier for the clinician to visualize mentally caloric needs than surface area (in square metres!), the use of Darrow's criterion does, in fact, duplicate

and complicate matters, except for those who are accomplished 'electrolytologists'. To have two standards of reference, weight and metabolic turnover, is confusing, and there is no question but that:

'Divers weights and divers measures, both of them are alike abominations to the Lord.' (Proverbs, 20:10).

However, by a happy coincidence, this difficulty may be resolved—at least in babies up to the age of one year, when fluid and electrolyte problems are especially frequent and urgent.

The metabolic turnover criterion is by no means ideal. It is also somewhat of an estimate, for it must take into account not only basal metabolism, but physical activity, fever, environmental conditions and other factors. When it is stated that the water requirements for an individual (young or old) are 150 c.c. per 100 calories metabolized, it must be borne in mind that the 100-calories criterion itself varies with metabolic rate and that caloric needs at any one time can only be gauged with somewhat rough accuracy.

A formula for calculating caloric needs has been suggested by Wallace,[8] but this gives figures which are rather on the high side for older children and adults. A more useful modification for calculating caloric requirements in individuals who are ill (and perhaps feverish) in bed is:

Calories Required/Kg. of Body Weight = 100 − (4 x Age in Years).

This formula is valid until the age of 17 or 18 years, adult standards being then reached. It will be noted that this formula makes use of *age* as a standard for caloric needs, reflecting the difficulties of using weight alone as a criterion. It is thus possible to estimate fluid and electrolyte requirements on the basis of this formula and to supply these needs according to Darrow's standard of 100 calories metabolized.

Scrutiny of the formula reveals the rather convenient fact that up to the age of one year an infant needs roughly 100 calories per Kg. It is clear then, that in the first year of life, Darrow's standard of 100 calories metabolized (shall we call this 1 Darrow Unit (D.U.)?) is equivalent to 1 Kg. insofar as water and electrolyte needs are concerned. The earlier statement that an individual requires 150 c.c. water per 100 calories metabolized (i.e. per Darrow Unit) is now seen to indicate that, in the first year of life, an infant needs 150 c.c. per Kg.

With increasing age this parallelism no longer holds true, for after the first year, caloric requirements decrease sharply, and by adolescence and adulthood, the caloric requirement for individuals confined to bed by illness is something like 30 calories per Kg. In this situation it is clear that 1 'Darrow Unit' will be equivalent, not to 1 Kg., but to about 3–4 Kg. By the end of the first year a correspondence still exists between Darrow Units (100 calories metabolized) and Kg., for at this age many babies are about 10 Kg. and therefore need about 1,000 calories daily (10 Darrow Units). Thereafter Darrow Units increase at a much slower rate as compared to the increments in weight, so that (say) 13 Darrow Units (1,300 calories metabolized) is equivalent—as a standard of reference—to roughly 15 Kg., 17 Darrow Units to about 30 Kg., and 18–19 D.U.'s to about 60 Kg., and this 18–19 D.U.'s is likely to be the 'ceiling' for the formula, applying to adults as well—for, while ill they do not require more than 1,800–1,900 calories daily, unless their non-fatty weight is much in excess of 60 Kg.

Hence, when it is written that the insensible skin loss of water (in the absence of overt sweating) is in the order of 28 c.c. per 100 calories metabolized (i.e. per D.U.), it will be clear that for practical purposes (up to the age of one year) this is equivalent to stating that the insensible skin loss is 28 c.c. per Kg., provided the infant is not markedly obese. As far as adolescents and adults are concerned (where each D.U. is equivalent to about 3 Kg.), the skin loss may be stated to be 28 c.c. per 3 Kg., i.e. 9 c.c. per Kg. By means of calculating caloric requirements (and hence D.U.'s) at various ages, it is possible to standardize Darrow Units against weight. To use the same example for (say) a child of 5 years:

Caloric needs are 100 − (4 x 5) = 80 calories per Kg.

The weight of the child will be known. It is likely to be (say) about 20 Kg.

Therefore total caloric requirement would be 80 x 20 = 1,600 calories.

Hence in this instance 16 Darrow Units are equivalent to 20 Kg.

If insensible loss is 28 c.c. per D.U., then (in terms of Kg.) the loss would be

$$\frac{28 \times 16}{20} = 22 \text{ c.c. per Kg.}$$

All this is necessary to indicate the difficulties of standardization for the purposes of supplying fluid and electrolytes. It is possible, of course, to draw up nomograms plotting the caloric needs (D.U.) against the weight, just as these have been done with respect to surface

area plotted against weight. In the case of D.U., however, this is unnecessary, because:

1. 100 calories metabolized is something which the clinician (and especially the paediatrician) can 'visualize' more readily than surface area in square metres.

2. In the first year (when fluid problems are most urgent) there is a virtually perfect parallelism and correspondence between D.U. and Kg.

3. Thereafter this connexion between caloric standard and weight can easily be established by means of calculating the caloric needs according to the modified Wallace formula. It should be remembered that the formula holds true up to adolescence, when the weight is likely to be about 60 Kg. Thereafter, even though age increases and weight usually increases, the caloric needs remain roughly the same as at adolescence, i.e. about 30 calories per Kg., or rather less in old age.

Moreover, it should be remembered that the standard for fluid and electrolyte requirements is itself usually so variable and so uncertain that it is impossible to cling to mathematical precision in calculating losses and needs according to any standards whatever. Variations in standardization of up to 15%[9] and even 25%[3] are quite in order and, indeed, inevitable; so that it is sufficient to use a rough approximation regarding the relationship between D.U. and Kg. In infancy, 1 D.U. is equivalent (as a standard of reference) to 1.0 Kg. and the earlier calculations will have made it plain that:

1 D.U. is roughly equivalent to 1.2 Kg. during the nursery school years.

1 D.U. is roughly equivalent to 1.5 Kg. during the early primary school years.

1 D.U. is roughly equivalent to 2.0 Kg. at about 10 years.

1 D.U. is roughly equivalent to 2.5 Kg. at puberty.

1 D.U. is roughly equivalent to 3.0 Kg. at adolescence and in adults.

FURTHER DIFFICULTIES

The make-up of the body lends further difficulties to estimations and understanding of fluid disturbances. This make-up is not uniform and varies with age and with position within body sectors. The chief body constituent is water, and this contributes about 80% of the total weight in prematures and some 60–65% in adults. The water is distributed into intracellular and extracellular (interstitial + vascular) compartments according to 'the rule of 5': Some 50% of the water is intracellular, about 15% interstitial and 5% intravascular.

This scheme could apply reasonably well to adults, although the 50% for intracellular would be more accurately written as 45%. For infants, however, these proportions are rather different, because they have much more extracellular water. Despite this larger volume of interstitial fluid, they do not have a decreased susceptibility to dehydration. Quite the reverse, for their obligatory 'turnover' of body fluid is very rapid as a consequence of their rapid rate of metabolism, so that water lack becomes manifest much more readily. 'Water flows through the infant three times as fast as through the adult,' quipped Gamble, 'which explains an unpopular item of the infant's social behaviour.' Of all the extracellular fluid distributed throughout the body, something like 30% of it is contained within the skin of the young infant, which explains the diagnostic usefulness of this tissue.

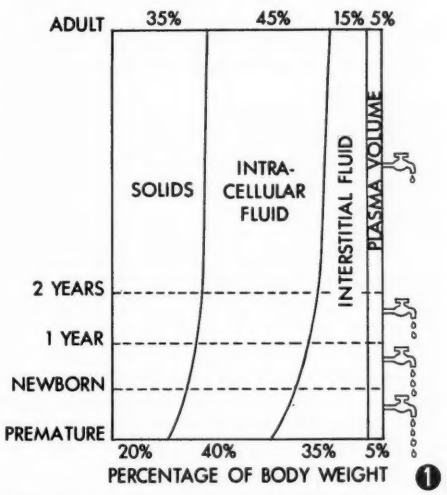


Fig. 1. Body Compartments and Fluid Turnover.

In premature infants something like 40% of the body weight is extracellular water, 35% in the newborn, and about 25–30% in children 1 year of age, the adult pattern being approximated at about the age of 2–3 years. Fig. 1 illustrates the changes in body compartments with varying age. Plasma volume remains constant at roughly 5% of the body weight. Also illustrated is the fact that fluid loss (and hence turnover) is proportionately greater the younger the child.

Unfortunately, no method exists of estimating with reasonable accuracy absolute deficiencies or excesses in water content of the various body sectors. Sudden loss or increase of weight may give one a good indication of water alterations, but were we to discover an easy and accurate method of assessing absolute alterations in compartmental content of water we would possess an invaluable tool for checking clinical situations and impressions.

Another difficulty is that the body electrolytes are not uniformly distributed. While there is very little difference between plasma and interstitial fluid (the latter has considerably less protein content), there is a great deal of difference between these and intracellular electrolyte distribution. The cell contains massive quantities of potassium and magnesium, both of these being but poorly represented within the extracellular fluid, and while this has about 140 mM. (or mEq.) per litre of sodium, intracellular sodium is little more than 10 mM. per litre. Routine clinical investigations are performed only on plasma so that plasma results do not necessarily reflect changes of like kind within the intracellular compartment. Therefore calculations based on plasma electrolytes may enable one to judge pretty accurately the status of the interstitial fluid; but in order to make allowances for intracellular alterations, one makes use of little more than intelligent guesswork.

(To be continued)

ENDOSCOPY OF THE BILIARY DUCTS

PROF. DR. MED. H. GRIESSMANN *

From the Surgical Department of the Municipal Hospital of Neumünster, Holstein

I. BILIARY DUCTS: FREQUENCY AND CAUSES OF THE RE-OPERATIONS NECESSARY

The main concern and also one of the most difficult things in bile surgery is a reduction (*a*) in the number of repeated operations and (*b*) in the remaining complaints. Until a few years ago we had at our disposal only methods for the pre- and especially for the intra-operative exploration of the biliary ducts. These methods were completely uncertain in their results and permitted only indirect conclusions about the conditions in the interior of the biliary ducts.

The quota of the re-operations necessary in the biliary ducts is still too high to-day. Dammann and I (1956) reviewed the results in over 2,065 biliary operations;[7] of these 77 required re-operations and 25 of these 77 died. The death rate for cases of re-operation was 32.5%.

Precise investigation of the different re-operations demonstrated that stone was overlooked in 22.1% and the so-called new formation of stone occurred in 7.8% of cases. I dare say that new stone formation occurs only very rarely and that most of the new formations must be classified with overlooked stones. Therefore an overlooked stone has to be made responsible for one-third of all cases of re-operation. Mallet-Guy[19] found stones in the biliary ducts in 17% and Hess[12] in 36% of all re-operations. The statements of Millbourn[21] are very instrucive and interesting. He concluded that stones were definitely left in the biliary ducts after surgery for choledocholithiasis in 15% of cases, and in 14% very probably, although he nearly always employed operative cholangiography. Even higher percentages were reported by Kourias *et al.*[18] (63%) and by Rathcke[25] (84%). Rathcke, who referred to all cholecystectomies with or without choledochotomies, found stones in the main biliary duct. These figures of course do not give an exact idea of the frequency with which stones are left in the ducts; for a certain proportion of operated patients are not treated by the surgeon and so the position cannot be accurate statistically. In spite of this the aforementioned figures show very clearly that in a considerable percentage one does not succeed in eliminating all obstacles even though very careful examination is made of the biliary ducts by customary methods. Palpation, sounding of the common duct with metal sounds and other instruments, washing and re-palpation with bougies, the test of the patency with the aid of the syringe experiment of Payer, the modern procedure of operative cholangiography, radiomanometry and the use of the palpation instrument developed by Kirby,[17]—none of these led to the desired result even when all these different methods were used. They give only an indirect idea

* Director and Chief Surgeon.

of the condition of the inner ducts and are not of great importance as far as the exact assessment of kind, extension and localization of abnormal changes in the biliary ducts are concerned.

II. SURVEY OF THE DEVELOPMENT OF ENDOSCOPY OF THE BILIARY DUCTS

During the last 30 years the only attempt was to make the biliary ducts directly visible to the eye. The first experiments on optical investigation of the interior of the great biliary ducts were made by Bakes[1] who in 1923 in Brünn began to insert a laryngoscope-like instrument into the biliary duct. By this method he carried out 40 choledochoscopies. After a statement by Simon-Weidner[29] in 1926 the Italian Antonucci (Georg Wolf, Berlin) invented an instrument in which the light source was connected with the optical system. He published his experience with this new method in *Policlinica.* In 1941 McIver[20] constructed an optical instrument with which he was able to look into the common duct. His instrument consisted of a rectangular investigating lens with light source and a shaft connected with a canal for flushing fluids. But these authors did not succeed in refining their methods so that they could be applied routinely. Their instruments did not get known and were soon forgotten.

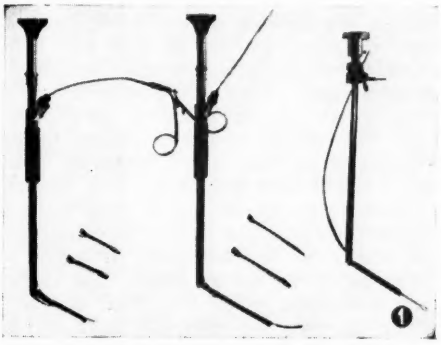
Wildegans[30] found new ways for the diagnosis of biliary disease with the construction of a useful endoscope for the deep ducts. By making use of the latest techniques in the construction of endoscopes, he was the first to invent an easily handled instrument which is very suitable for giving exact information about the conditions in the interior of the hepatic and the common duct. This instrument was presented for the first time in 1953, at a congress of surgeons in Munich. In years he has published various papers dealing with the technical and diagnostic possibilities of operative endoscopy of the biliary ducts. In 1956 he published the results of his first experiences with the technique and the diagnostic possibilities of operative endoscopy of the biliary ducts in case of cholelithiasis.[31] At the end of his paper he states:

'The present information may stimulate critical testing and application of endoscopy.'

Since April 1956 I have used this method in all cases in which anatomically endoscopy is possible. I obtained very surprising results in more than 300 endoscopies carried out so far. I will report these findings here. In the course of the years endoscopy of the biliary ducts has received support from Griessmann,[4-9] Guderlei,[10] Hänisch,[11] Jeliner,[13] Kourias,[18] Mollowitz,[22] Mönch,[23] Keller,[14-16] Simon-Weidner,[29] as well as from the French authors, Richard[27] and Lortat-Jacob.

III. THE DIFFERENT ENDOSCOPES AND THE SUPPLEMENTARY INSTRUMENTS

The choledochoscope of Wildegans is furnished with a lens with a light source and a flushing mechanism incorporating a biliary sound. By an incision in the common duct the instrument can be guided in the direction of the duodenum and the liver. To-day we have the following different instruments (Fig. 1).



The choledochoscope originally developed by Wildegans (produced by the firm Sass, Wolf & Co., mbH., Berlin) was supplied in the sizes of 18, 20 and 25 Charrière. The only disadvantage of this instrument is that one cannot change the size in one and the same instrument, for there existed many different instruments which were available in the already mentioned sizes. The stronger models were provided with a recoil washing in which the flushing water flowed back in a second pipe through the instrument from a conduit. One could separate the optic and the lighting circuit from the flushing apparatus which could be cleansed in boiling water. The choledochoscope of the strength of 18 was provided with a movable ocular piece with which one could set the picture exactly and it was also possible to correct any vision defect. As to size it was best suited to the practical requirements but as to size and illumination of the field of view it was not as good as the thicker models.

The firm, Wolf of Knittlingen, constructed a choledochoscope to the specifications of Simon-Weidner. This showed many advantages com-

pared with the original instrument (Fig. 1B). In this instrument the angle between the shaft and the end is 60°. The great advantage is that, according to the size of the choledochoscope, one can screw on sleeves of the different sizes of 15, 18 and 20 Charrière, thus enabling the surgeon to bring into view also a thin hepatic duct, using only one instrument. The sleeves, which can be screwed on, are round except for the operating sleeve, in order to adapt themselves best to the anatomical proportions and to make rotation possible round the axle of the end without doing any damage. The distal end is blunt, and is easily introduced through the choledochotomy opening into the hepatic duct. The flushing liquid does not leave the end at the side but runs through the opening of the sleeve into the field of vision, passing the lens and light source, thereby widening the space in front of the instrument. Thus it is possible to see a longer distance in the course of the exploration. The end can be moved 66 mm. in the direction of the liver or the duodenum. The optical line of sight amounts to 165°. Besides a flushing pipe the shaft of 11 mm. contains a canal through which flexible supplementary instruments can be introduced. It begins at the height of the douche nozzle. The instrument constructed by the firm, Wolf of Knittlingen, has many supplementary parts such as a probang (pincer-like), forceps for excision, flexible injection cannula, wire ring for splitting the papilla, needle electrode, button electrode for coagulation so that slings and catheters can be inserted to one's liking.

Following my proposal the firm, Wolf of Knittlingen, were so kind as to construct a further instrument the sleeves of which are considerably shorter (Fig. 1). This instrument (which was constructed for pyeloscopy) is also very well suited for endoscopy of the biliary ducts. In very fat patients or very complicated anatomical conditions it may be rather difficult to insert the longer endoscope in the direction of the duodenum, but it can nearly always be managed in the direction of the liver. In all these cases the pyeloscope provided with short sleeves that can be screwed on may be used for endoscopy of the hepatic ducts.

Lately Sass-Wolf of Berlin has changed his instrument in a similar way so that sleeves of different widths with cone closing can be fixed over the end of the lens. The sleeves have the sizes of 15 and 18 Charrière. The width of the operating sleeve is 20 Charrière. Also many flexible supplementary instruments can be used. Both firms construct a supplementary apparatus for taking photographs so that different authors (Griessmann, Keller, Schega, Simon-Weidner, Wildegans) have succeeded in taking very useful colour photographs of the inner biliary ducts.

For cleaning and sterilizing the instruments the sleeves are removed. The instruments are first washed in alcohol and then put in a 0.5% Zephiran chloride solution for half an hour. Afterwards the instruments have to be sterilized in formaldehyde-gas for at least 24 hours. The danger of bacterial contamination of the operation wound is also lessened by changing the gloves after having used the instrument. Schega[28] protects the hands and the instrument from contact with the face by wearing a sterile face-mask of cloth containing two eye holes.

IV. USE OF THE INSTRUMENTS

Though the endoscope is generally inserted at the point of the choledochotomy incision, I must stress that in many cases endoscopy can also be done through the wider cystic duct. If the width of the cystic stump makes insertion possible, this method of endoscopy should always be used before opening the common duct, for in many cases the choledochotomy, and consequently drainages that might be necessary, become superfluous because all the biliary ducts can be inspected, after which the cystic duct can be tied. The common duct must be opened only if insertion through a narrowed cystic duct is not possible or if the common duct cannot be inspected from the cystic because of certain valve formation or of too inclined an inosculation into the common duct. Typically it is opened after placing 2 threads at the cystic junction. This spot is very suitable as no great nerves or vessels can be injured.

Of course the necessary care which is required for every sounding has also to be taken with endoscopy. The endoscope must be inserted lightly and in a resilient way. Any force to overcome any obstacles must be avoided. In case of a very narrow duct, endoscopy cannot be done. In no case should one use force and thus bring about a mechanical overstretching of the tissues, which are perhaps inflammatory and damaged and which may cause lesions and haemorrhage of the mucosa. In the case of too steep an insertion one must be very careful because the posterior wall of the common duct may be perforated. This steep insertion occurs if the distance from the point of the choledochotomy insertion to the liver is very short and attempts are therefore

made to enter more easily into the common duct by means of a rather steep position of the instrument. In these cases one should rather use the short instrument built as a pyeloscope, because the insertion can easily be carried out without this steep position. This short instrument has, of course, the disadvantage that one cannot see the common duct up to the papilla. It is inserted with an illuminated bulb and a sterile isotonic saline solution is used for flushing. It is advisable to let the flushing fluid run just a short time before the instrument touches the operation wound, to avoid soiling the objective with blood when the instrument is inserted. The pressure of the flushing liquid which comes out must be such that the biliary ducts are easily widened.

After careful packing off of the abdominal cavity with cloths, the flushing liquid that flows back is immediately sucked off at the choledochotomy point with a sucking instrument. If the papilla is open and the endoscope inserted up to the duodenum, the greatest part of or even all the flushing water flows off into the duodenum. If greater quantities run into the duodenum and therewith retrogradely into the stomach, which may be caused by working for too long at the papilla, it is advisable to suck off the water immediately with a gastric suction drain. It can be recognized from the exterior if the water flows easily into the duodenum, because in such a case the duodenum is completely filled with the liquid. If the water flows back in great quantities it demonstrates, to a certain extent that the papilla shows a smaller or larger obstruction. The handling of the instrument and the clinical assessment of the findings are very easy for those who have experience with other endoscopes, e.g. cystoscopes or bronchoscopes.

First one inserts the instrument up to the liver in order to get an idea of the ramifications of the hepatic branches, of the width of the ducts, of the nature of the secretion in the biliary ducts as well as of the state of the sides and of possible tumourous or inflammatory changes and of the location of the stones in the hepatic duct and deep in the liver. Afterwards the instrument is inserted in the direction of the duodenum to investigate the state of the papilla and of the area round the papilla as well as of the whole common duct. This duct, which becomes narrow infundibularly in the direction of the papilla, has the aspect of a cylindrical tube with an orange-coloured and smooth surface; its mucosa is not interrupted by any villi or holes but presents itself in longitudinal folds on which ramify reticularly slight vessels of a darker colour. Very often one can find at the side directly before the papilla a characteristic crescentic fold.

One gets a very good formative idea if the instrument is inclined in different directions to right, left, upwards and downwards and if it is moved forwards and backwards. The rotation of the end around the logitudinal axis of the shaft is also important. On the way from the insertion opening to the papillary opening in the duodenum the endoscope passes through the different sections of the main biliary duct, viz. the supra- and retro-duodenal part and the intra-pancreatic and the intramural section of the common duct. The supra- and retro-duodenal parts are nearly of the same length and expand most in case of stasis in the gall system. Inside the pancreas the common duct becomes rather narrow compared with the proximal parts. In this area it is surrounded by the pancreatic capsule and therefore it cannot expand very much in case of obstruction.

After having passed the pancreas the common duct enters diagonally the side of the duodenum while it narrows conically even more. This part is about 1 cm. long and corresponds to the papilla duodeni with the sphincter of Oddi. At this point the pancreatic duct falls into the common duct in 60% of all cases. It is very strange that one can see the ostium of the pancreatic duct with the endoscope only rather seldom as a slanting slit or cleft in a longitudinal fold of the biliary duct. To get a good view of the papilla it is advantageous to incline the instrument to the right and to the left and thereby make even the curves of the biliary ducts which are physiological; but it is possible that they are increased by obstruction in the gall system or by changes of an inflammatory or tumourous nature in the area of the head of the pancreas. In a closed state the lumen of the papillary opening is of the size of a pin and is surrounded in most cases by 4 reddish toruses which correspond to the longitudinal folds of the mucosa of the pars intramuralis of the common duct. These folds lie closely against one another because of the contraction of the sphincter. If the flushing liquid does not succeed in unfolding them the papilla looks like a slanting slit which is formed in that way because the sides of the duct lie against each other.

In nearly all cases the end of the endoscope is long enough to look into the duodenum.

One can recognize the duodenum by its typically thin and velvet-like duodenal villi which line the lumen of the intestine. Besides the mucosa has a darker colour than in the common duct. The hepatic duct and its branches can be seen even better than the common duct. The sides are stronger and therefore in most cases better unfolded. Generally the mucosa does not differ from that of the common duct. The branching of the hepatic duct presents itself in very nice oval ostia. Very often, and especially in the case of obstructed hepatic ducts, it is possible to see the duct up to the third and further divisions. Generally the left hepatic duct is wider than the right but has only small branches. The right one, on the other hand, separates immediately into cranial-ventral and dorso-caudal branches. The biliary ducts display great variations in size and in branches.

V. THE INDICATION FOR ENDOSCOPY OF THE BILIARY DUCTS

Endoscopy can fail if the common duct is too narrow or the access to the deeper biliary ducts impossible because of tumour masses or scarred changes or coalescences, so that the instrument cannot be moved freely. *If the width of the common duct allows endoscopy, endoscopy of the biliary ducts is carried out,* if possible from the direction of the cystic duct. Choledochotomy and endoscopy of the biliary ducts have the same indications. Above all choledochotomy and also endoscopy are indicated in the following cases:

1. In cases of icterus, past or present.
2. If the gall bladder has small concretions or mud.
3. If the cystic duct is remarkably dilated.
4. If the hepatic or the common duct is very widened.

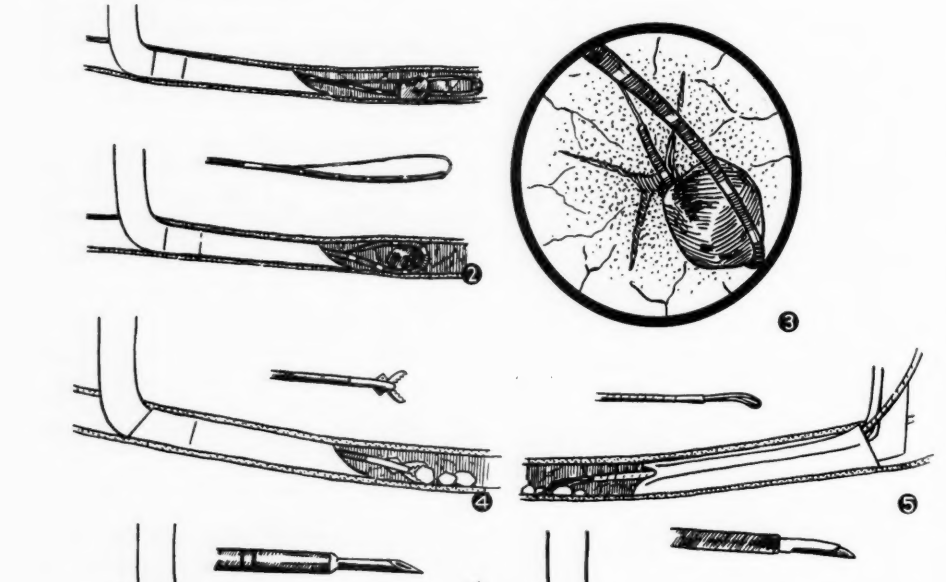


Fig. 2. Application of the Zeiss sling.
Fig. 3. The stone caught by the sling in front of the papilla.
Fig. 4. Removal of little stone particles with small pincers provided with teeth.
Fig. 5. Removal of stone rests with a sweeper.
Fig. 6. Use of an injection cannula.
Fig. 7. Application of the electric knife.

5. If puncture of the biliary ducts shows turbid or muddy bile.
6. After acute necrosis of the fat tissues of the pancreas.
7. If one can feel a remarkable induration in the region of the head of the pancreas.

In all these cases one has to reckon with stones or other obstacles that hinder emptying of the branching ducts. Later on in another connexion I shall speak of *an unusual* diagnosis that may be made when the ducts appear to be free, if endoscopy is only carried out because the cystic duct makes it easily possible.

VI. THE DIFFERENT TECHNICAL POSSIBILITIES OF OPERATIVE ENDOSCOPY OF THE BILIARY DUCTS

Figures 2 and 3 demonstrate the introduction of a sling through the instrument to grasp and remove a stone in the common duct. In this case the original urology Zeiss sling was used. While the Davis sling is much more useful in urology than the original Zeiss sling, I use the original Zeiss sling successfully in endoscopy of the biliary ducts. If the stones are very very small one cannot grasp them with a sling but must use fine pincers.

Fig. 4 shows how to remove small stone particles with pincers which are provided with little teeth. Another way of clearing the duct is to insert a small metal sweeper with which the stones are swept off (Fig. 5).

By using an injection cannula (Fig. 6) one can inject Novocaine-Privin to cause a deturgescence at the papilla as with the ostium of the ureter in urology. To avoid a stenosing papillitis we may use many different instruments. First one can insert an electric cutting knife which is isolated from the surroundings (Fig. 7).

Besides it is possible to insert a small wire sling up to the papilla in order to slit it electrically, as with the ostium in the bladder (Fig. 8).

Fig. 9 shows the possibility of slitting the papilla with a small pair of scissors which can be stretched out after having been inserted into the papilla and which have a blade outwards.

Fig. 10 represents a simple needle electrode which can be used for electrical slitting as in the slitting of the ostium. This instrument is also very suited for levering jammed hepatic stones, as is indicated on the right side of Fig. 10. With a simple button electrode bleeding can be stopped and the depths of a wound can be coagulated (Fig. 11).

For excision we use small pincers with sharp branches (Fig. 12).

This survey gives an idea of the many possibilities of endoscopy. By using all these instruments it is, moreover, possible to replace greater operations by smaller ones which are less dangerous (e.g. in a case of stenosing papillitis) but above all to remove all stones from the deep intra-hepatic ducts up to the papilla so that one may expect that re-operations for mostly not newly formed but overlooked stones will be lessened considerably or disappear altogether.

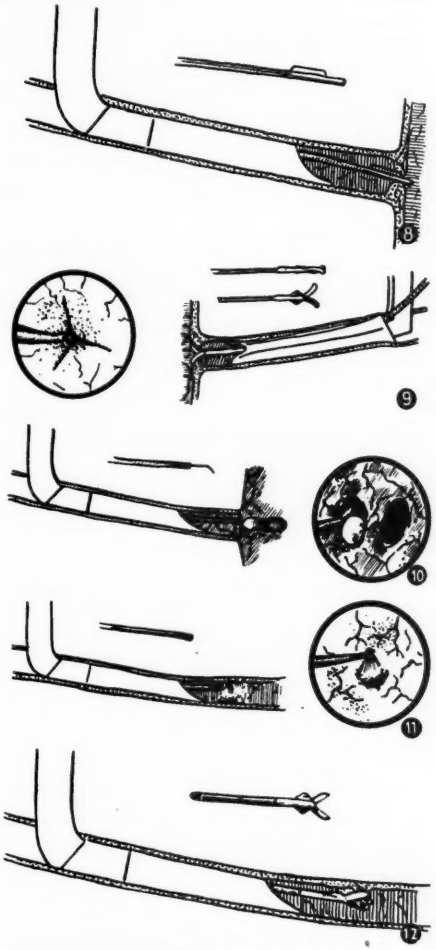


Fig. 8. Slitting of the papilla with an electrical wire sling.
Fig. 9. Use of scissors to slit the papilla.
Fig. 10. Application of the needle electrode used as an electric slitting sound and as a 'stone lever.'
Fig. 11. Application of the button electrode to stop bleeding.
Fig. 12. Pincers with sharp branches for excision.

VII. FREQUENCY OF STONES IN THE BILIARY DUCTS

The stones in the biliary ducts derive in most cases from the gall bladder. The primary stone formation in the biliary ducts is certainly possible but extremely rare. This possibility is proved by the finding of stones in the intra- and extra-hepatic gall passages in cases of congenital absence of the gall bladder.[25] Many authors are of the view that lithiasis in the common duct is not at all a rare illness. According to a list of Wildegans for the year 1952, in every sixth or seventh person ill with stones in the biliary duct, one or more stones were found in the common duct. Reiferscheidet[26] found stones in the biliary ducts in 16% of all cholecystectomies and Demel[3] reported lithiasis in the common duct in 20%. Hess[12] stated that in the same hospital before the introduction of cholangiography, stones were found in the common duct only in 7.8% of the whole gall material and in 25.7% after regular application of cholangiography. This fact proves that the method of cholangiography has caused a considerable improvement and also points to the fact that endoscopy of the biliary ducts, which surpasses cholangiography remarkably in its value, must bring about another improvement in the operations on patients with stones in the biliary ducts. In our review of the 2,065 patients ill with stones Dammann and I concluded that in 21% the gall bladder and the biliary ducts were affected. Kourias[18] found the figure of 19.7% and Hänisch 26% in which the biliary ducts were concerned, though both these authors used nearly the same methods of examination.

(*To be concluded*)

NOTES AND NEWS : BERIGTE

Dr. Basil L. Goldschmidt, M.Med. (Paediatrics), Cape Town, D.C.H. (Lond.), has recently commenced practice as a consultant paediatrician at 208 Pier House, Heerengracht, Cape Town. *Telephones*: — *Rooms*: 3-6337; *Residence*: 71-5345.

* * *

Dr. E. Alan Price and Dr. Percy Reichman of 401 Medical Arts Building, Jeppe Street, Johannesburg, have, in addition to their town rooms, commenced a branch radiological practice at Suite 1, First Floor, Asklipion Medical Centre, corner of Geranium and Albert Streets, Rossettenville Corner, Johannesburg. (*Telephone*: 26-1169).

* * *

FACULTY OF ANAESTHETICS IN THE ROYAL COLLEGE OF SURGEONS, IRELAND

This Faculty was recently established. Of the 37 Foundation Fellows elected, three are South Africans, viz.:

Prof. O. V. S. Kok (University of Pretoria);
Dr. Arthur B. Bull (Cape Town);
Dr. P. Mesham (Natal).

* * *

GENERAL PRACTITIONER REFRESHER COURSE

The Medical Graduates Association of the University of the Witwatersrand announces that its next post-graduate refresher course for general practitioners will be held from 16–21 January 1961 (inclusive).

Dr. P. F. H. Wagner, of East London, has returned to South Africa after a visit overseas, during which he attended the annual meeting of the British Medical Association at Torquay in his capacity as President of the Medical Association of South Africa.

Dr. Wagner was accompanied by Mrs. Wagner.

* * *

Dr. M. C. Gerber, M.B., Ch.B., D.A. (Wits), has commenced practice as an anaesthetist in partnership with Dr. L. Rautenbach, at 602, Lister Building, Jeppe Street, Johannesburg.

(*Telephones*: — *Consulting Room*: 23-4733; *Residence*: 59-1515).

* * *

At the meeting of the South African Medical Council held in Johannesburg in September it was reported that, on 30 June 1960, there were 7,895 medical practitioners on the Register.

* * *

A COURSE IN HYPNOSIS

The Society for Clinical and Experimental Hypnosis (Northern Section), is considering running a course of instruction in hypnosis for doctors, dentists and psychologists.

Doctors who are interested in participating in this course should write to:

Dr. B. W. Levinson, Tara Hospital, Hurlingham, Johannesburg.

PREPARATIONS AND APPLIANCES

HIRUDOID

Rigor, calor and dolor, the classical criteria of a locally circumscribed inflammatory process, are frequently also described as accompanying thrombotic and phlebitic (thrombo-phlebitic) conditions. Therapy with *Hirudoid* aims at *inhibiting and shortening* these processes and above all, along the principles of leech-therapy (modern heparin therapy) at the dissolution of the blood clots (anti-coagulant effect).

Hirudoid (manufactured by *Luitpold Werke, Munich, Germany*) is now being introduced in South Africa by the *Newport Trading Corporation (Pty.) Limited*, Johannesburg.

Hirudoid is a *standardized organic preparation with heparinoids* as active principles contained in a white neutral ointment base.

Extensive clinical experience as well as experimental laboratory tests with *Hirudoid* prove that a *percutaneous absorption* of the heparinoids takes place. It is of particular importance to stress that the organic substances of the product do not require the presence of a skin-irritating agent for permeation. The standard against which the anticoagulant effect of *Hirudoid* is experimentally measured is the known coagulation time of human blood (recalcification of citrate blood and/or plasma, thrombin time of citrate blood and/or plasma, the Heparin Tolerance Test). On the average, an objective prolongation of the clotting time by 52% was found to be the case as a *result of topical Hirudoid application,* when an optimal specific effect is seen after about 6 hours. Whilst an undesirable (sometimes unpleasant) pronounced *hyperaemizing effect* is avoided, the full absorption of the specifically active substances brings about the rapid remission of subjective symptoms (pressure, pain). Besides, the anticoagulant effect, there is a noticeable antiphlogistic and fibrinolytic action which occurs with the first application.

Hirudoid is indicated for topical use in traumatic and pathological conditions near the surface of the skin, e.g. haematomata, contusions, thrombosis, phlebitis, thrombo-phlebitis, varicose veins, ulcus cruris, furuncles, inflammatory infiltrations due to injections, adnexitis, parametritis, etc.

Hirudoid is applied in a layer or on a mousselin-pad on the inflamed or thrombotic surface or around the open ulcus once or twice a day, until the condition has subsided. No side effects.

Supplied in tubes of ½ oz., 1½ oz., 5½ oz.

REFERENCES

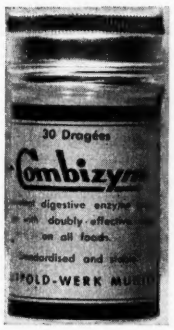
O. Brunner, *Praxis,* 45. Jahrg. No. 9, 1956.
J. Roesner, *Die Medizinische,* No. 7, Feb. 1959.
H. Ptasnik, *Therapie der Gegw.,* year 96, Nov. 1957.
A. Schuster, *Mediz. Klinik,* No. 23, June 1956.
Holzknecht, *Schweiz. Med. Wochschr.* 84, Feb. 1954.
F. Felsani, *Archivio ital. di scienze mediche tropicali e di parassitologia,* vol. 39, Jan. 1958.

Further information on *Hirudoid* and samples will be gladly supplied by the importers:

Newport Trading Corp. (Pty.) Ltd., P.O. Box 1871, Johannesburg.

COMBIZYM

Total enzyme substitution in cases of gastro-enteric metabolic disturbances and their ensuing symptoms (dyspepsias, cachexia, flatulence, meteorism, hypoproteinism, etc.) represents the principle of a novel approach to these diseases by means of *Combizym* tablets manufactured by *Luitpold Werke, Munich, Germany,* now being introduced in South Africa by the *Newport Trading Corporation (Pty.) Ltd.,* Johannesburg.



Combizym, a *multivalent* ferment compound, is composed of fungus (plant) and pancreatic enzymes (cellulase, amylase, protease, esterases, lipase, trypsin) in a *high and acid-resistant concentration* which makes it eminently suited for the treatment of *all types* of in- or maldigestion of foods *throughout the whole of the digestive tract,* its action starting in the stomach (acid medium) and continuing through the duodenum and the small and large intestines with an alkaline reaction (pancreatic enzyme part). The addition of lipase will make up for bile deficiency in cases of bile disorders as the responsible etiological factor involved, (idiopathic steatorrhea), that of cellulases for the normally lacking ability of the human organism to metabolize and digest the flatulent vegetable foods (plant structures of cabbage, etc.). Just as it remains active in hypo- and hyper-acid media, *Combizym* takes over the functions (by way of substitution) of certain metabolic processes normally generated by the gastric and pancreatic ferments, viz. if and when the respective pathological processes are involved (fermentative insufficiency, chole- and hepatopathies, pancreopathies). *Combizym* is thus an ideal enzyme treatment of the 'gastro-enteric syndrome' of a rather complex nature and origin (idiopathic, allergic, neural and pathological).

Combizym aims at the removal of the symptoms (flatulence, fullness, meteorism, etc.) and at the increased absorption of fats, proteins and carbohydrates (also iron) through complete metabolic break-down in the digestive tract. It prevents the formation of waste products (indol) in the small and large intestine which may, in turn, cause certain auto-intoxications. Remission is spontaneous or gradually achieved (post-operatively).

Routine Treatment: 1–2 tablets swallowed whole with meals.

REFERENCES

H. Trautman, *Med. Monatsschr.,* vol. 13, No. 2, 1959.
F. Rausch and H. Harwerth, *Arztl. Forschg.,* No. 4, 1957.
G. Ballauf, *Fortschritte d. Med.,* vol. 77, Jan 8, 1959.
G. Schettler, *Arztl. Woch. Schr.,* year XI, No. 25/26, 1956.

Further information on *Combizym* and samples will be gladly supplied by the sole importers:

Newport Trading Corporation (Pty.) Ltd., P.O. Box 1871, Johannesburg.

STELADEX SPANSULE CAPSULES

Formula: Each *Steladex Spansule Capsule* contains 2 mg. trifluoperazine and 10 mg. *Dexedrine* (Dexamphetamine sulphate).

Indication: Overweight, especially when psychoneurotic factors underlie the condition. *Steladex* alleviates the stress of dieting as well as curbing the appetite of the patient on a low-calorie diet.

Steladex curbs the patient's appetite all day long with one morning dose. It suppresses any psychoneurotic factors underlying the obesity and leaves the patient composed but alert.

Contra-Indications and Side Effects: Use with caution in the presence of severe hypertension, advanced cardio-vascular disease or extreme excitability.

Side effects, chiefly nervousness and insomnia, are infrequent, mild and transitory.

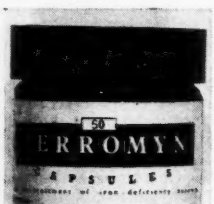
Dosage: One *Steladex Spansule Capsule* daily, taken in the morning.

Presentation: Sustained release *Spansule Capsules* in container of 30.

Further information may be obtained from:
SKF Laboratories (Pty.) Ltd., P.O. Box 38, Isando, Transvaal.

FERROMYN

Westdene Products (Pty.) Ltd. announce the introduction of *Ferromyn*, a modern concept of oral iron therapy from the Research Laboratories of Calmic Ltd., England.



Ferromyn is prepared from the mild atoxic ferrous salt of succinic acid and is now clinically established as the most effective organic iron salt. It requires no other additive to produce a rapid haemoglobin response or to reduce intolerance of side effects usually associated with oral ferrous therapy. By virtue of its superior utilization and absorption, haemoglobin increase of approximately 24% can be obtained with *Ferromyn* after only 17 days from the commencement of therapy.

Cope *et al.*,[1] in a controlled clinical trial found *Ferromyn* taken orally to be as effective as intravenous and intramuscular iron in all but a few refractory cases, and they consider it the product of choice even for severe degrees of iron deficiency anaemia. Furthermore, *Ferromyn* has a remarkably low incidence of intolerance, reported by Gillespie[2] to be less than 1%. By virtue of its bland properties *Ferromyn* is particularly suitable for infants or children and for administration throughout the course of pregnancy.

Ferromyn is available in the form of capsules and as a palatable elixir. The average dosage is one capsule or one teaspoonful 3 times a day.

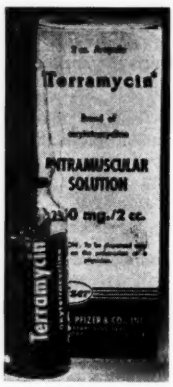
Further information may be obtained from the sole South African distributors, Westdene (Pty.) Ltd.

REFERENCES

1. Cope, E., *et al.*, B.M.J., **2**, 638, 1956.
2. Gillespie, R. M., 1955, Medical Illustrated, **9**, 147.

TERRAMYCIN

READY-TO-USE PRECONSTITUTED INTRAMUSCULAR SOLUTION



For the first time in South Africa a broad-spectrum antibiotic is now available in a ready-to-use preconstituted intramuscular solution. This *new* form of *Terramycin* comes in a 250 mg. ampoule, for once-a-day dosage.

Terramycin intramuscular therapy is now reduced to the same price level as oral therapy, a welcome development for both the profession and the patient.

International reports on *Terramycin* intramuscular solution show excellent tolerance and a remarkable freedom from pain.

It is also reported that within 15 minutes of injection by the intramuscular route, *Terramycin* reaches high, therapeutically effective serum levels with a broad range of activity.

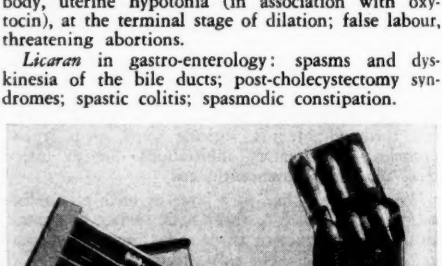
The 2 c.c. ampoule is pre-scored and spillproof. By simply snapping the top, the solution is immediately available for aspiration.

LICARAN (UNION CHIMIQUE BELGE, S.A.)

LICARAN PHENETAMINE, A SPASM-RELAXANT OF SMOOTH MUSCLE

Indications: *Licaran* in obstetrics during labour; cervical spasms, incoordinated contractions of uterine body, uterine hypotonia (in association with oxytocin), at the terminal stage of dilation; false labour, threatening abortions.

Licaran in gastro-enterology: spasms and dyskinesia of the bile ducts; post-cholecystectomy syndromes; spastic colitis; spasmodic constipation.



Comments: *Licaran* is a spasmolytic of the papaverine type. Its effectiveness extends to a whole range of spasms: intestinal, induced by barium chloride; uterine, induced by pituitrine; ureteral, induced by prostigmine.

Packings: Tablets, 50 mg., Bottles of 20 and 100. Ampoules, Boxes of 3 and 25. Suppositories, Box of 6.

Distributors: Scherag (Pty.) Ltd., P.O. Box 7539, Johannesburg.